



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Anjian Wu	Project Number J0734
Project Title Semiconductor Lighting	
Abstract Objectives/Goals My objective is to understand the operation of Light Emitting Diodes (LED) and determine if modern LEDs have the advantages to replace incandescent light bulbs for energy-saving purposes. Methods/Materials The primary materials used include high-brightness LED samples in red, green, and blue. I constructed a 70-piece-LED assembly based on appropriate number of green, red, and blue LEDs so that it would emit white light. A high-efficiency AC-DC conversion circuit is used to power the LEDs. The assembly was then tested along with nitrogen and halogen incandescent lamps to find their efficiencies. This was done by adjusting the input power at different points and measuring the light output. Results The LED assembly designed and constructed by me successfully matched incandescent light bulbs in light output. The LED cluster showed strikingly high conversion efficiency: 8x better than a nitrogen incandescent light bulb and 5x better than a halogen lamp. Conclusions/Discussion LEDs are five to eight times more efficient than incandescent light bulbs. This is because light generation from LEDs is through transitions of electrons between energy states, with little loss in heat. Although each LED is small, when combined into a group, high luminance comparable to light bulbs can be obtained, with less waste of energy. LEDs have other advantages such as their relatively constant color and high efficiency regardless of input power. Incandescent light bulbs, on the other hand, depend on heat radiation to generate light with lots of waste energy. Also, at low wattages, the light wavelength of the bulbs is long and is mostly infrared, which is invisible. It is only at high wattages when the light becomes more visible.	
Summary Statement This project is to explore the potential of Light Emitting Diodes (LED) as an efficient lighting source by constructing a LED assembly and comparing its performance against incandescent light bulbs.	
Help Received Father taught me theory of semiconductors, helped acquire LED samples and advised on designing AC-DC converter. Father also participated in valuable discussions of experimental results.	