



**CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY**

Name(s) Dhruv Aggarwal	Project Number 35785
Project Title Spotlight on Infrared Radiation: Luminous Flux or Radiant Flux?	
Abstract Objectives/Goals My objective was to determine what makes performers feel hot on stage, and whether it is the light that falls on the body creating the heat, or whether the heat from the bulbs is travelling to the performer. I also wanted to understand how the heat traveled, because it is invisible. Since the light sources generated both light, and heat, I had to either keep the light or the heat constant, or find a way to separate the light from the heat. My hypothesis was that the temperature of the measured surface would increase due to the heat rather than the light. Methods/Materials My method was to keep the Luminous Flux (lumens) constant, so that the heating would be only due to the infrared radiation. I created a setup using bulbs and an LED light, measured the baseline temperature calibrating across three different thermometers, and then exposed the skin pad and later human skin to the lighting for 20 minutes, measuring every 5 minutes. Finally, I eliminated the effect of difference in lumens from the light sources by confirming the results with half the lumens for the bulbs. Results The temperature of the skin pad and human skin increased by 1.5 degrees every 5 minutes with the incandescent bulbs, and by 0.5 degrees every 5 minutes with the LED lights. (Incandescent bulb had 300% increase as compared to the LED). Even with half the lumens the incandescent bulb had a 200% increase and the halogen bulb had a 133% increase as compared to the LED. My data also confirmed the Inverse Square Law for radiation. When testing on my skin, with the LED and Halogen bulbs, there was a decrease in temperature of 0.6 and 0.2 degrees, respectively, since my body regulated its temperature. With the incandescent bulb, the temperature increased by 0.1 degrees, since the bulb produced more heat than my body could dissipate. Conclusions/Discussion My hypothesis was substantiated: Luminous Flux was approximately the same, so the light sources had to be radiating infrared waves (Radiant Flux) that was travelling to the measured surface. Recent advances in LED technology have improved their CRI, so that the light is comparable to that from Halogen bulbs, and I expect that it will be increasingly adopted on stages, improving the environment for performers.	
Summary Statement This project studies the visible light and infrared regions of the electromagnetic spectrum in an effort to reduce the heat experienced by performers on stage.	
Help Received My parents funded my project and helped me set up the electrical wiring.	