CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
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Project Number
J1221

Project Title
How Full Is Full Spectrum?

Abstract

Objectives/Goals
My objective was to evaluate the claims of "full-spectrum" light source manufacturers in order to determine whether their products imitate the qualities of sunlight more accurately than ordinary light sources. Additionally, I sought to determine which of the light sources tested would produce a spectrum most similar to that of sunlight, and to determine which of these light sources would produce a spectrum least similar to that of sunlight. I hypothesized, based on qualitative experience, that the spectrum of the Ott-Lite Tru-Color fluorescent desk lamp would most resemble the spectrum of sunlight, and that the spectrum of the GE Crystal Clear incandescent bulb would least resemble the spectrum of sunlight. I also hypothesized that the lights advertised as "full-spectrum" would produce spectra which resembled the spectrum of sunlight more closely than lights not marketed as "full-spectrum."

Methods/Materials
My apparatus consisted of a light-tight chamber with a small slit on top to admit a single ray of light. A lens focused this beam of light onto a diffraction grating mounted at a 45° angle to the incoming light. The light was diffracted into its spectrum and reflected onto an index card marked with quarter-inch reference lines. I tested 10 different light sources in this way. A digital camera was then used to take high-resolution images of these spectra, which were uploaded onto a computer. For each spectrum, Adobe Photoshop 7 was used to extract RGB values from 11 sample points at regular intervals, resulting in a total of 110 sample points. I calculated the summed squared deviation between the data gathered from each light source's spectrum and the spectrum of sunlight.

Results
I found that the Ott-Lite Tru-Color fluorescent desk lamp was the most similar to sunlight, with a squared deviation of 10.8. The GE Soft White compact fluorescent bulb resembled sunlight the least, with a squared deviation of 167.1.

Conclusions/Discussion
The Ott-Lite Tru-Color fluorescent desk lamp did resemble sunlight the most, but in my experiment, the GE Crystal Clear uncoated incandescent bulb, with a squared deviation of 44.4, was not the most dissimilar to sunlight. The four "full-spectrum" lights I tested were the most similar to sunlight. These results indicate that the lamps do stand up to the manufacturers' claims, and will reproduce the qualities of natural sunlight more effectively than other light sources.

Summary Statement
Using a spectrometer built around a diffraction grating, a digital camera, and Adobe Photoshop, I quantitatively analyzed the spectra of full-spectrum light sources to evaluate thier similarity to sunlight.

Help Received
Father helped with spectrometer design; science teacher provided guidance.