CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
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Project Number
J1010

Project Title
Enhancing Light Transmission through Solar Bottle Bulb in Homes without Electricity

Abstract

Objectives/Goals
What is the optimal design for the most effective solar bottle bulb to be used in homes without electricity?

Methods/Materials
1. Construct lightproof box w/ 4 light sensors. 2. Establish control w/ indoor constant light. 3. Test light transmission of following variables: bottle size,shape,color, cap color, angle of bottle placement, existence or absence of reflective paint/foil reflector cones, solutions in the bottle (MgSO4, Salt Water, Mineral Oil, No solution). 4. Take 4 luminance readings for each variable. 5. Repeat the same trials using outdoor natural sunlight. 6. Compare current solar bottle vs improved model vs skylights. 8. Compare results to identify optimal design to improve light transmission.
Materials:Light meters, plastic bottles & caps, mineral oil, bleach, water, MgSo4, NaCl, reflective paint, foil, Xenon light source, duct tape, glue gun, 60 watt lightbulb,boards, nails, tape measure, plumbers putty, protective eyewear

Results
Testing 8 independent variables that may affect light transmission and conducting 212 indoor and 148 outdoors (total 360) trials showed that a 2 liter, clear, cylinder shaped bottle with white opaque cap, filled with tap water, no reflective paint band and no reflector cone transmitted 52% more light (1694 Lux) than current solar bottle bulb. A 60-watt light bulb produced 2862 Lux. When the solar water bottle was replaced with a skylight made of plastic pane from soda bottle over the same opening, the light transmission was 1077 Lux. A larger opening (same size as current roof panel) covered with double plastic pane yielded most light transmission at 4285 Lux.

Conclusions/Discussion
Results from 360 trials of 8 independent variables showed that increasing bottle size, using water & white cap increased light transmission. Use of reflectors & reflective paint blocked light transmission. None of the solar bottles produced light levels that were even close to the light of a 60-watt light bulb. Depending on the size, a skylight can produce as much or more light as the solar bottle bulb and can be better than 60-watt light bulb. The skylight can be constructed in 1/72 of time it takes to make a solar bottle. The method of creating a larger opening in the roof of the houses and covering it with plastic pane made of soda bottles may be a more cost-effective & efficient alternative that should be explored to illuminate homes without electricity.

Summary Statement
Improving the design of solar bottle bulb for use in homes without electricity.

Help Received
Dad helped construct lightbox & record results;mom helped with display