California Science Center

CALIFORNIA STATE SCIENCE FAIR
2000 PROJECT SUMMARY

Your Name (List all student names if multiple authors.)
Gregory P. Schuster

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J0120

Project Title (Limit: 120 characters. Those beyond 120 will be ignored. See pg. 9)
How does changing the shape, type, and size of reflective surfaces affect the temperature gain of a solar reflector?

Division
J Junior (6-8) J Senior (9-12)

Preferred Category (See page 5 for descriptions.)
9 - Fluid Mechanics/ Aerodynamics/ Thermophysics

Abstract (Include Objective, Methods, Results, Conclusion. See samples on page 14.)
Use no attachments. Only text inside these boxes will be used for category assignment or given to your judges.

OBJECTIVE: Solar reflectors are often used in solar cookers, especially in Third World countries. My objective was to study the properties of reflectors by changing three variables: shape, type (the surface material) and size of the reflective surface in a solar reflector, to see resulting temperature differences. These results might be used in a design for efficient solar cookers. I conducted two experiments.
METHODS: EXPERIMENT 1) studied shape and surface type. Designed and constructed 4 small solar reflectors boxes: all identical, but each had a different reflective surface shape: flat, v-shape, semi-circle, and parabola. I also changed the surface type using various reflective materials: black-, white- and silver-paper, aluminum foil and mirror tiles. As a control, I built a 5th reflector box, which had no reflective surface- to record the temperature of my apparatus without the variables of shape or surface type. Testing methods: I installed the same surface type in all the reflectors, and aimed them at the sun. I took their temperature every 15 minutes, recording the temperatures in data tables and then re-aimed them. I repeated this for 1 hour, then changed the surface type in all the boxes and began again, repeating the process until all surface types had been tested.
EXPERIMENT 2) Used a large parabolic cylinder, to study changes to surface size, using values for size of: 24", 48", 72", and 96". Testing methods: I began with 24" of mirror tiles exposed, and took the temperature each 15 minutes and then re-aimed the apparatus. Once a stable temperature was reached I exposed more mirror tiles to bring me to the next study value. I repeated the process until all surfaces sizes had been tested.
RESULTS/CONCLUSIONS: My hypotheses were (1): a parabola shape with the largest surface area and the most reflective surface type (mirrors) would provide the greatest temperature gain. (2): that the semi-circle shape will be second. I proved these hypotheses to be true. The mirror surfaces provided the highest overall temperatures in all shapes. The largest parabola tested (96") provided the highest temperature #exceeding 550° F! The semi-circle shape performed next best. I could now apply the results of this experiment toward the design of a solar cooker.

Summary Statement (In one sentence, state what your project is about.)
I studied designs for solar reflectors, by testing 3 variables- shape, type and size of reflective surfaces, and proved the best design was a parabola shape using mirrored surfaces, with the greatest surface area.

Help Received in Doing Project (e.g. Mother helped type report; Neighbor helped wire board; Used lab equipment at university X under the supervision of Dr. Y; Participant in NSF Young Scholars Program) See Display Regulation #8 on page 4.
My father, Kerry Schuster, helped me build the reflectors. My father and mother, Ann, reviewed my project report. My father helped me refocus the apparatuses (a two-person job). My father showed me computer software tips so I could make my own displays and format my report. The Creighton#s critiqued my District display.