



Colorado Science and Engineering Fair

2024 Individual Project Abstract Form

Please print 2 copies of the completed form. Sign both copies, keep 1 for your notebook and submit 1 copy to your Regional Fair Director with your other paperwork.

Title of Project: Calcium Carbonate Cooling Caps

Finalist's Name: Cole Randolph

School and City: Green Mountain High School, Lakewood

Sponsor's Name: Jen Flores

Category: Chemistry (CHEM)

Division: Senior (9th - 12th grades)

Abstract (250 words or less):

As world temperatures continue to rise, the risk of contracting heat related illnesses grows as well for those spending extended periods of time outdoors. High school athletes are especially susceptible to heat-related illnesses as many outdoor practices occur during the hottest parts of the day. To solve this issue of overheating, the clothing athletes wear needs to be considered. This project focuses on how simple changes to dye pigments within clothing can significantly change cooling capabilities of clothing. The pigment used in this project is calcium carbonate (CaCO_3). Various studies have shown that CaCO_3 exhibits properties which allow it radiate heat extremely effectively through black body radiation. In this project, CaCO_3 was synthesized using solutions of calcium chloride (CaCl_2) and sodium carbonate (Na_2CO_3). The resulting CaCO_3 crystals were then added to different dye solutions, and soaked into uniform cotton baseball caps. These caps were worn by human participants whose head temperatures were tracked over time. The caps cooled users up to 16% more effectively than traditional white caps. Participants also judged each cap for comfort, with the majority stating that chemically treated caps were just as comfortable as normal baseball caps. Based on temperature data and user feedback, the integration of CaCO_3 into clothing reduces body surface temperatures without sacrificing comfort.

I hereby certify that the above statements are correct and the information provided in the Abstract is the result of one year's research. I also attest that the above properly reflects my own work.

Finalist's Signature: 

Date: 3/3/2024

In addition, all students must complete the ISEF Student Checklist (1A), Research Plan, Approval Form (1B), and Checklist for Adult Sponsor (1), and any other ISEF forms required for this type of project. See the International Rules and Guidelines for form requirements. Return COPIES of all of these forms to your Regional Fair Director with you Finalist Verification/Permission Form. A signed copy of this form must be included in your notebook.