



**CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY**

Name(s) Cassia A. Jones	Project Number J1310
Project Title Future Fabrics: Using Carbon Nanotube-Coated Cotton to Create Efficient Wearable Heaters	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Keeping people warm is a worldwide problem. With my project, I attempted to create an efficient heating device made from cotton strips saturated with a solution of carbon nanotubes. When dry, this creates a wearable fabric that can produce heat when electricity is passed through it. When electrons pass through the jumble of carbon nanotubes, they create vibrations in surrounding molecules, which creates heat. The treated fabric retains its normal traits, such as softness and flexibility. My hypothesis is that I can make an efficient heater out of cotton coated in a solution of carbon nanotubes, sodium lauryl sulfate, and water.</p> <p>Methods/Materials For my project, I dipped 4 cm x 2 cm strips of cotton in a solution made from water, 1.5 mg/mL multi-walled carbon nanotubes, and 10 mg/mL sodium lauryl sulfate. The sodium lauryl sulfate was to keep the carbon nanotubes from clumping together. After dipping the samples multiple times, I dried them in the oven at about 120 degrees Celsius and tested their resistance with a multimeter. If the cotton sample had the appropriate resistance, I tested its ability to generate heat by running 30, 40, or 50 volts of electricity through it using a regulated power supply. I recorded the temperature of the fabric every thirty seconds using a digital thermometer for five minutes and for 2 additional minutes after turning it off.</p> <p>Results By dipping my samples multiple times, I was able to lower the resistance from over 60 mOhms to less than 10 kOhms. After preparing my samples, I tested my samples at 30, 40 and 50 volts with currents of about 0.002 amps. When connected to power, the samples heated up rapidly to over 50 degrees Celsius despite using only about 0.1 watt of power. They also cooled down very quickly.</p> <p>Conclusions/Discussion Carbon nanotube-coated cotton is highly efficient in producing heat (up to 52 degrees Celsius), has low resistance (less than 10 kOhms), and is suitable for wearing. Treating cotton with carbon nanotubes only requires a simple water-based solution and easy dipping methods. Treated cotton still remains soft and flexible. Carbon-nanotubes bind tightly to cotton fibers and do not easily rub off. The resistance of the dipped cotton can be lowered through multiple dippings. The lower the resistance, the higher the heating temperature of the sample.</p>	
Summary Statement My project is about creating an efficient, wearable heater made from cotton dipped in a solution of carbon nanotubes.	
Help Received My father provided me with the necessary supplies for the project as well as showed me how to preform the procedures safely. My grandfather suggested the idea for the project.	