



**CALIFORNIA STATE SCIENCE FAIR  
2006 PROJECT SUMMARY**

<b>Name(s)</b> <b>Katharine J. Russell</b>	<b>Project Number</b> <b>J1535</b>
<b>Project Title</b> <b>Are Good Electrical Insulators Also Good Thermal Insulators? A Study of Thermal Conductivity</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> My experiment is to test which materials work best as thermal insulators. My hypothesis is that a good electrical conductor would be a bad thermal insulator. This hypothesis was based on my observation that copper is used in most electrical wires because it is a good electrical conductor; it is also placed on the bottom of pans because it conducts heat well. This leads me to believe that a material like an aerogel is a good thermal insulator because it is a bad electrical conductor.</p> <p><b>Methods/Materials</b> I will test my hypothesis by taking different materials (electrical conductors and electrical insulators) and placing them next to a source of controlled heat and measuring, with a thermometer, how long it takes for the other side of the object to reach an equilibrium temperature. I will then use Fourier's equation to calculate the thermal conductivity.</p> <p><b>Results</b> Using the temperature vs. time plot for each of the materials, I determined the equilibrium temperature and used Fourier's equation to calculate the thermal conductivity. The best thermal insulator is PVC, it had a thermal conductivity of 1.185(W/mK). In order of best thermal insulator to the best thermal conductor I then found polyethylene with a thermal conductivity of 2.11(W/mK), teflon 3.018(W/mK), steel wool 3.762(W/mK), oak 3.985(W/mK), silicon dioxide 4.006(W/mK), acrylic plexiglass 4.106(W/mK), poplar 4.606(W/mK), fiberglass 4.69(W/mK), polystyrene 4.994(W/mK), silica aerogel 8.755(W/mK), gypsum 10.18(W/mK), ceramic (Macor) 16.316(W/mK), marble 25.474(W/mK), silicon 106.692(W/mK), aluminum 114.502(W/mK), steel 122.388(W/mK), and finally copper with 185.5(W/mK).</p> <p><b>Conclusions/Discussion</b> The material that was the best thermal insulator was PVC. I found, from my background research, that PVC is a very bad electrical conductor which is consistent with my hypothesis. Copper was the best thermal conductor. Copper is well known for its high thermal conductivity and is used in many things such as the bottom of cooking pans so that the pans heat up faster, and in electrical wires because it is also a good electrical conductor. My hypothesis said that I thought a good electrical insulator would be a good thermal insulator, which was shown to be correct.</p>	
<b>Summary Statement</b> My experiment measures thermal conductivity to test which materials work best as thermal insulators.	
<b>Help Received</b> Science teacher Mr. Ozeni gave pointers to improve my experiment; English teacher Mrs. Williams taught me how to do my background research paper and abstract; my Dad got the materials and monitored my experimnt to keep things safe.	