



**CALIFORNIA STATE SCIENCE FAIR  
2017 PROJECT SUMMARY**

<b>Name(s)</b> <b>Kelsey C. Ewing</b>	<b>Project Number</b> <b>S1809</b>
<b>Project Title</b> <b>Thermal Effects of the Radiofrequency Electromagnetic Fields Emitted from Cellular Phones on the Human Body</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> This study examined the thermal effects of the radiofrequency and electromagnetic fields emitted from cellular phones on the human body. A potential causal relation was investigated: does the temperature of the human body increase when exposed to the radiofrequency and electromagnetic fields emitted from cellular devices? Such changes in thermal activity are significant because research studies have shown that although the radiofrequency and electromagnetic fields emitted from cell phones are non-ionizing, they have been found to cause thermal increases in the human brain. It was hypothesized that the model(s) of iPhone emitting the highest levels of the radiofrequency and electromagnetic fields would also result in the largest increase in body temperature.</p> <p><b>Methods/Materials</b> Levels of radio frequency waves and electromagnetic radiation emitted from 4 iPhone models at pre-determined distances (50mm, 25mm, 10mm, 0mm) were measured utilizing an electromagnetic field (EMF) meter. Then, the internal and surface thermal effects on the subject's body at each given distance were measured using an ear thermometer, a digital infrared surface thermometer, and an infrared thermo-imaging camera. Multiple (640) trials were conducted using 4 phones, 4 distances, pre-exposure readings, and both sides of the head (left and right). Finally, surface and internal thermal measurements were cross-analyzed with the EMF data.</p> <p><b>Results</b> Data was analyzed using Chi Square. Pick#s Theorem was used to map and analyze the surface thermal changes. Increases in surface temperature in the region closest to the antenna (orbitofrontal cortex and temporal lobe) significantly increased (95% CI, p=.004) after exposure. The iPhone 7 Plus yielded the largest increases in surface (4.5°C) and internal (.9°C) temperatures. The iPhone 7 Plus yielded the highest level of magnetic radiation (60 MG), while the iPhone 5 yielded the highest levels of electric radiation (300 v/m). The iPhone 7 and the iPhone SE emitted the highest levels of radio frequency radiation (.3 mW/cm<sup>2</sup>).</p> <p><b>Conclusions/Discussion</b> Positive correlations were found between the magnetic radiation emitted from cell phones and increases in surface and internal temperature. No significant correlations were found between electric or radio frequency radiation and thermal change. This research project provides data that will allow cellphone users to protect their health as knowledgeable consumers.</p>	
<b>Summary Statement</b> My project involves the testing and studying of the thermal changes caused by cellular phones in relation to the radiofrequency and electromagnetic fields emitted from each model of phone tested.	
<b>Help Received</b> Thank you to my advisor and mentor for prompting me to go further with my data analysis.	