



# CALIFORNIA STATE SCIENCE FAIR 2017 PROJECT SUMMARY

<b>Name(s)</b> <b>Caitlin M. Gorin</b>	<b>Project Number</b> <b>J1410</b>
<b>Project Title</b> <b>Developing a Prototype Case that Reduces Electromagnetic Fields Emitted from Cellular Devices</b>	
<b>Objectives/Goals</b> The objective of this engineering project is to develop a Prototype Case that reduces H-Field Radiation emitted from Cellular Devices by 10%. Cellular Device usage continues to increase, raising concerns about a possible link between Electromagnetic Field (EMF) Radiation and adverse effects to human health (cancer, sleep disorders, and development problems). It would be beneficial for Cellular Device users to have a protective cover that minimizes H-Fields. <b>Abstract</b> <b>Methods/Materials</b> This is a 3-Phase Engineering Project that evaluates Cellular Devices' H-Field levels and Materials for filtering Magnetic Radiation using an EMF Tester. Test Run: Measure H-Field levels from all 6 sides of the Cellular Device, at 3 distances (Direct Contact, 8", and 24" Away) while playing a video or 3 Test Tone Frequencies (200 Hz, 350 Hz, and 500 Hz). Phase-1: Measure H-Fields in the area. Phase-2A: Build a Faraday Cage out of aluminum mesh and wood. Phase-2B: Conduct Test Run on multiple Cellular Devices (iPhone 6S, Samsung S3, Samsung S7, iTouch 4, iPad Mini 4, Tab E 8, Note 10.1, and iPad 1). Select the device with the highest Average H-Field. Phase-2C: Make Screens from different Materials (Plastic, Conductive PLA, Carbon Powder, Iron Filings, Iron Oxide, and Aluminum) and repeat Test Run 3 times with the Selected Device by itself and with each Screen, to identify the Material with the lowest Average H-Field. Phase-3: Design and Fabricate Prototype Case based on Phase 2 Selections. Repeat Test Run 3 times with Selected Device by itself and with the Prototype Case. Analyze H-Field Averages to determine if Objective has been met. <b>Results</b> Phase-1: Store Entrances and Electronics Areas have high H-Fields. Phase-2: Highest H-Field - Samsung S7. Due to popularity, iPhone 6S was also tested. Conductive PLA had the lowest Average H-Field, followed by Iron Filings. Phase-3: 3D-Printed Prototype S7 Phone Case using Conductive PLA and then coated it with Iron Filings. Prototype reduced Average H-Fields levels by 15.8%. <b>Conclusions/Discussion</b> Prototype met the 10% Reduction Objective with a value of 15.8%. Only partial success can be declared since Direct Contact Front and Back H-Field values exceeded EMF Tester maximum levels ( $>20\mu\text{T}$ ) for all Cellular Devices and were excluded. This project supports using conductive materials Carbon Black (found in Conductive PLA) and Iron Filings to manufacture a case that filters H-Field Radiation.	
<b>Summary Statement</b> Developing Prototype Case made from Materials that reduce potentially harmful Magnetic (H-Field) Radiation emitted by Cellular Devices.	
<b>Help Received</b> My father showed me how to use the tools to build the Faraday Cage and taught me how to use the CAD software so that I could design the Prototype Case.	