



# CALIFORNIA STATE SCIENCE FAIR 2016 PROJECT SUMMARY

<b>Name(s)</b> Thomas (Casey) C. Hubbard	<b>Project Number</b> <b>J0913</b>
<b>Project Title</b> One Quarter Wavelength Ground Plane Antennas	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> My objectives were: To build a 2m and a 70cm one-quarter wavelength ground plane antenna; to determine their standing wave ratio (SWR) and resonant frequency to see how well I built them, and finally to use my amateur radio handset to test their transmit and receive capabilities with other HAM radios and stations and compare it to the factory made 2m/70cm dual band antenna included with my radio.</p> <p><b>Methods/Materials</b> I used 12 gauge copper wire and SO-239 UHF/VHF connectors to construct the antennas' radiator/radial wire elements. Two BAOFENG GT-3TP Mk3 Two Way Ham Radios and two FCC Ham Radio Operator#s Licenses were also required to conduct my tests. I used a MFJ 209C Antenna Analyzer and a MFJ 886 B- Frequency Counter to determine the SWR and resonant frequencies of the antennas I built. For the Repeater and Simplex tests I selected several repeaters in the area and transmitted to them with my antennas on the low, medium, and high power (1, 4, and 8 watts) settings and listened for a response. I then rated the clarity and volume of the transmission. The same process was used for the simplex tests at varying distances.</p> <p><b>Results</b> I successfully built a 2m and a 70cm one-quarter wavelength ground plane antenna and tested them. The 2m one-quarter wavelength ground plane antenna target frequency was 147 MHz, testing showed its resonant frequency was 146.856 MHz with a SWR of 1.1. The 70cm one-quarter wavelength ground plane antenna target frequency was 440 MHz, testing showed its resonant frequency was 440.025 MHz and a SWR of 1.05. The antenna with the best performance was the 70cm one-quarter wavelength ground plane antenna, broadcasting to beyond 12 kilometers. The second best antenna was the 2m one-quarter wavelength ground plane antenna which was able to broadcast 12 kilometers. The factory made dual band antenna was only able to broadcast 2 kilometers on the 70cm band and 3 kilometers on the 2m band.</p> <p><b>Conclusions/Discussion</b> My tests proved that I was able to build two one-quarter wavelength ground plane antennas that worked well for the 2m and 70cm radio bands. The testing for repeaters and simplex broadcasts were able to show that the overall best antenna is the 70 cm one-quarter wavelength ground plane antenna; which broadcasted further and clearer than the dual band factory made antenna or the 2m one-quarter wavelength ground plane antenna.</p>	
<b>Summary Statement</b> I constructed and tested two one-quarter wavelength ground plane HAM radio antennas and proved they worked by measuring their SWR and resonant frequency as well as testing them across multiple frequencies within their radio band.	
<b>Help Received</b> I designed and constructed the antennas with oversight from my father. Mr. Johnson and Mr. Boss assisted by providing the antenna analyzer and frequency counter which I used to determine the SWR and resonant frequency of the antennas I constructed.	