



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

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Project Title Soundwaves: Goodbye to Noise Pollution	
<p style="text-align: center;">Abstract</p> <p>Objectives Noise pollution, such as generated from airplanes, traffic, and construction can have negative effects on human health and lower quality of life. The objective of my experiment is to explore the possibility of cancelling noise pollution, without the use of headphones. Noise cancelling headphones function due to the property that two identical sources of sound can cancel each other if they are 180 degrees out of phase. My experiment investigates the possibility of using the same theory of wave interference in open air.</p> <p>Methods I built a sound stand with two speakers out of phase by 180 degrees. I played pink noise from one speaker, measured the decibel level, then activated the second speaker as the noise cancellation and re-measured the volume. During the experiment, I varied the separation distance of the two speakers to determine if distance between source and cancellation device had an impact. I also took volume measurements at different angles and distances from the sound source to study changes in the amount of noise cancelled at different positions in a room. In total, I measured the noise cancelled at 77 different configurations. The materials I used were a sound stand with speakers and an amplifier, decibel meter, tripod, and cell phone. Inside the house, I noticed several issues with sound reflecting off walls and furniture. As such, I collected more data outside where there were fewer objects to reflect the sound.</p> <p>Results Certain configurations showed promise, reducing noise levels by as much as 7dB and other configurations actually increased the noise pollution by as much as 3dB. The results indoors showed major challenges due to sound reflections off walls, furniture, and household items which reduced the effectiveness as distance from the cancelling speaker increased. The data collected outside showed consistent noise reduction regardless of the distance from the sound stand since there were fewer objects to produce echoes. Off angle measurements, however, continued to pose a challenge.</p> <p>Conclusions Noise pollution can be reduced using open air noise cancelling technology if the challenges of sound reflection and the positional dependence of constructive interference can be addressed. There are still major challenges, however, with open air noise cancellation that need to be addressed. Configurations where the noise cancelling speaker was not near the noise source or where the listener was not at 90 degrees from the speaker setup showed increased levels of noise.</p>	
Summary Statement I found that open air noise cancellation technology can reduce noise pollution if some critical challenges can be overcome.	
Help Received I designed the experiment, configured the trials, and collected the data entirely on my own. I built the sound stand with the help and supervision of my father. I also consulted with various experts at UCLA to form a basic understanding of wave interference and sound propagation through air.	