



**CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY**

Name(s) Zoe I. Geller	Project Number 36326
Project Title The Effects of Ultrasound on Magnetic Bacteria for a Cancer Therapy	
Abstract Objectives/Goals The objective of this study is to determine if magnetic bacteria are harmed by exposure to ultrasound. I did this to test an original idea, that magnetic bacteria could be used in a cancer treatment that would make use of ultrasound. The reason to consider using bacteria in a cancer therapy is that anaerobic bacteria collect in solid tumors, because most tumors are low in oxygen. The treatment would use a form of "sonogenetics", a technique where ultrasound turns genes on and off. The big picture would entail inserting cancer-killing genes into the magnetic bacteria, and these genes would be turned on by the ultrasound once the bacteria reach the tumor. However, for this idea to work the ultrasound should not negatively affect the bacteria, and this is what I tested. While the cancer treatment could make use of any anaerobic bacteria, I used magnetic bacteria because it's easier to judge the bacteria's overall health after exposure to ultrasound. I judge the health of the bacteria by measuring how they respond to an applied magnetic field. Methods/Materials I collected magnetic bacteria in mud from a local creek and placed them in several jars. The bacteria were visible under a microscope as they followed a magnet that I moved with my hand. The experimental jars were exposed to ultrasound, but not the control jars. Then I measured the size of a clump, or "spot" of bacteria that gathered towards a magnet. The health of the bacteria was judged by the size of the spot after 15 minutes and 30 minutes. For supplies I needed bacteria, jars, magnets, ruler, an ultrasonic cleaner, camera, and a timer. Results This study showed that exposure to ultrasound decreased the ability for these bacteria to move towards a magnet. In the first experiment, the average spot size of the magnetic bacteria for the control jars was 0.7 mm after 15 minutes, and 1.8 mm after 30 minutes. For the experimental jars, the average spot size of the magnetic bacteria was 0.4 mm after 15 minutes, and 1.0 mm after 30 minutes. Conclusions/Discussion The bacteria's health was damaged when exposed to ultrasound. Nevertheless, the cancer treatment might still work. The jars that hold the magnetic bacteria are filled with mud and sand that vibrates and possibly damages the bacteria. I call this the "boulders effect". My next test will avoid the boulder effect by keeping the sand away from the bacteria during exposure to ultrasound.	
Summary Statement I am testing if exposure to ultrasound leaves bacteria unharmed so that they can be used in a cancer therapy.	
Help Received I figured out what tests to do, built the equipment, and did all of the testing myself. I received help on part of the idea from my dad and help understanding the possible uses of sonogenetics from Dr. Sreekanth Chalasani of the Salk Institute.	