



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

Name(s) Aditya Tadimeti	Project Number S1124
Project Title The Effects of Different Aquatic Environments on the Rate of Polyethylene Biodegradation by Bacillus subtilis	
<p style="text-align: center;">Abstract</p> <p>Objectives The purpose of this experiment was to determine if Bacillus subtilis could degrade High-density and Low-density polyethylene in Freshwater, Brackish water, and Ocean water environments. I hypothesized that rates of polyethylene degradation would be highest in Freshwater samples containing Bacillus subtilis.</p> <p>Methods I set up 72 30.0 mL test tubes each containing water and a uniform pre-massed strip of either HDPE or LDPE. I split the test tubes into 3 groups, the first one being Ocean water samples that were mixed with pre-made Instant Ocean chemicals, making for a salinity concentration of roughly 35 parts per thousand. The second group was comprised of Freshwater samples that contained no added chemicals, and the third group was comprised of Brackish water samples that contained a salinity concentration of roughly 15 parts per thousand. All test tubes were added with a low concentration nutrient medium, but the salinity concentration remained roughly the same after the addition. I streaked Bacillus subtilis from a cultured petri dish onto 8 HDPE and 8 LDPE pieces within each water group, leaving the remaining 4 HDPE and 4 LDPE pieces without bacteria to act as controls. After all the trials, I calculated an average rate of degradation for each aquatic environment with bacteria and compared it to the mass changes in its corresponding control.</p> <p>Results Overall, polyethylene samples in freshwater exposed to bacteria experienced the highest amount of degradation, with HDPE and LDPE pieces having an average of 5.79% and 5.77% decrease in mass respectively over a period of 1 month. Brackish water samples with Bacillus subtilis underwent a similar mass percent change, with HDPE and LDPE samples degrading by 5.08% and 5.30% respectively. Ocean water samples with the bacteria experienced the least amount of degradation, with HDPE and LDPE samples having an average of 3.61% and 2.47% decrease in mass respectively. Samples without the bacteria remained at approximately the same mass, having an average of a 0.04 % decrease in mass.</p> <p>Conclusions I hypothesized that the highest decrease in mass would be when polyethylene was exposed to Bacillus subtilis in freshwater at 35 degrees Celsius. This hypothesis was supported by the experiment. This conclusion is consistent with the theory of osmosis, which explains why Brackish water and Ocean water samples experienced less degradation. However, the ability for Bacillus subtilis to degrade polyethylene in a multitude of aquatic environments indicates the possibility for its use to tackle plastic pollution in the oceans.</p>	
Summary Statement I determined that Bacillus subtilis is capable of degrading HDPE and LDPE in Freshwater, Brackish water, and Ocean water environments.	
Help Received Mr. Jeff Sutton assisted me in using scientific instruments in our school laboratory. Aside from that, I designed, built, and performed all of the procedures in the experiment myself.	