



# CALIFORNIA STATE SCIENCE FAIR

## 2015 PROJECT SUMMARY

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| <b>Name(s)</b><br><b>Arvind Ramachandran</b>   | <b>Project Number</b><br><b>J0217</b> |
| <b>Project Title</b><br><b>Waste Not, Watt Not: Effect of Coffee Grounds on the Efficiency of Microbial Fuel Cells</b>   |                                       |
| <div><div><b>Objectives/Goals</b><br/>Microbial Fuel Cells (MFCs) generate electricity using energy produced by bacteria when they break down organic waste. My project aims to determine if coffee grounds can be used to improve the efficiency of an MFC. I predicted that coffee grounds would improve the efficiency of MFCs because they contain high amounts of nitrogen, which promote bacterial growth.</div><div><b>Abstract</b></div><div><b>Methods/Materials</b><br/>I assembled 5 two-chamber MFCs using plastic containers. I used galvanized zinc mesh, carbon paper, and copper wires to construct electrodes. I made salt bridges by pouring a solution of water, agar-agar and salt into plastic tubes. I connected the electrodes in the two chambers with a solid wire for electrons to flow from cathode to anode. I connected the chambers with a salt bridge for hydrogen cations to move from anode to cathode. Each cathode chamber contained 705ml of water. The anaerobic anode chambers contained different concentrations of a mixture of soil and coffee grounds; I used 0% (control), 40%, 60%, 80% and 100% coffee grounds. I used a multimeter to measure the voltage and current generated by each MFC over 3 days, and repeated the experiment 3 times.</div><div><b>Results</b><br/>The Control (0% coffee) produced the least amount of electricity. MFCs with higher concentrations of coffee grounds produced higher voltage and current; MFC #5 (100% coffee) was the highest and produced 150mV on average. While MFC #5 (100% coffee) produced the most voltage, it was only marginally better than MFC #4 (80% coffee grounds). When measured over 3 days, the Control produced steadily increasing voltage, whereas other MFCs did not show consistent improvements over time.</div><div><b>Conclusions/Discussion</b><br/>In conclusion, my hypothesis that coffee grounds would improve the efficiency of MFCs was supported. MFCs containing coffee grounds were more efficient, and higher concentrations of coffee grounds increased the amount of electricity produced. The MFC containing only coffee grounds produced the most electricity in all three trials.</div></div> |                                       |
| <b>Summary Statement</b><br>My project examines the effect of coffee grounds on the efficiency of soil-based microbial fuel cells  |                                       |
| <b>Help Received</b><br>My dad assisted me in building the Microbial Fuel cell; my mom helped with the board; and my science teacher, Mrs. Nguyen, provided guidance throughout this project.  |                                       |