



# CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

<b>Name(s)</b> <b>Trevor Amarante</b>	<b>Project Number</b> <b>S1101</b>
<b>Project Title</b> <b>Bioreactors: Promoting Methanogenic Reproduction through the Recirculation of Leachate</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives</b> Compare the rates of decomposition in a standard landfill environment to those of a system in which leachate is cycled through. Determine if the recirculation increases the rate of decomposition and has the potential of being beneficial to landfills in the context of energy.</p> <p><b>Methods</b> The experiment was carried out in sealed systems simulating a landfill environment. There are two types: wet (bioreactor) and dry (leachate recirculation absent), of which three units each was built and used in each trial. Each was constructed with the capability to maintain pressure and contain all gases produced until the time of measurement and release through the use of a GEM 2000 (Gas Emission Monitor). Once constructed, waste (materials with a higher proportion being biodegradable) was placed inside each system between layers of soil, after which the system was sealed to ensure the containment of any gases produced. Water was introduced into the bioreactor systems at the beginning of the trial in amounts related to rainfall measurements and cycled through the system without any additions during the period of experimentation.</p> <p><b>Results</b> The percentages of gases related to the processes of decomposition were found in higher concentrations in the systems simulating the bioreactor conditions. There was a 0.8% increase in methane production from the control to the bioreactor, which when applied to the scale of an observed landfill is an increase of 8,904,508.8 BTU a day having the potential energy equal to 1,200,149.7 kWh.</p> <p><b>Conclusions</b> The determination that the establishment of bioreactor conditions increases the rates of decomposition can be used by landfills in efforts to both improve efficiency in waste management and become sites of renewable energy production. By increasing rates of decomposition, the concentrations of methane are more likely to reach levels at which they are capable of being used in energy production, a practice that if started, could serve as a source of economic benefit and job opportunity. In just the landfill observed, the economic value of such increases is a \$144,017.96 (US average kWh cost) or \$215,666.90 (California average kWh cost) a day increase.</p>	
<b>Summary Statement</b> Sealed environments were created to simulate both a standard landfill environment with dry conditions and a bioreactor with the recirculation of leachate in order to compare the decomposition rates and determine a more efficient system.	
<b>Help Received</b> I designed the testing apparatus and carried out the research and experimentation by myself entirely. I consulted engineers at a functioning land fill on the approval of the design as well as on the needed research on landfill processes and procedures.	