# Stimulated Growth of Biofilms in Microgravity to Fuel a Microbial Fuel Cell

Students from Valley High School in California approached LyoHUB as part of a project through the Quest Institute, an educational non-profit organization that develops and market STEM educational programs and support materials for K-12 schools globally. The mission of the Quest Institute is to introduce, intrigue, inspire and ultimately engage students to understand what it means to pursue STEM-based careers. Thequestinstitute.com

***Description:***

This experiment compares the performance of a biofilm-based microbial fuel cell on Earth with a biofilm-based microbial fuel cell in microgravity on the International Space Station (ISS), using *Shewanella Oneidensis*, an electrochemically active bacteria. Biofilms oftentimes have different properties than the bacteria they are made up of in terms of their ability to handle stressful environments and other characteristics. An electroactive biofilm could be more efficient than a bacterial colony in the making of a microbial fuel cell. They are measuring the voltage difference across both MFCs (microbial fuel cells) amplified by an operational amplifier to determine how the MFCs compare to each other over time using an analog-to-digital converter which then feeds the voltage data to a microcontroller.

***Procedure:***

A biofilm of S. Oneidensis was grown on graphite felt, sent to LyoHUB, and lyophilized. A chamber was then prepared with lyophilized S. Oneidensis graphite felt, Nafion proton exchange membrane, potassium ferricyanide solution, and copper wires. The chamber was sealed with epoxy, and bags filled with sodium lactate and tryptic soy broth. The tubing and pumps were connected to the chamber and liquid bags. Non-inverting amplification circuits were constructed using operational amplifiers.

***Lyophilization:***

LyoHUB lyophilized two trials of graphite anodes with Shewanella Oneidensis. Within each trial, the anodes were lyophilized with a specific excipient or no excipient to test the viability of the lyophilized bacteria. Each independent variable of the excipient was run in triplicate to determine with sufficient certainty whether Shewanella Oneidensis was able to survive after lyophilization. For excipients, 0.3 g of whey powder, 0.75 g of trehalose and 0.75 g of milk powder were used with no excipients.

Lyophilized product

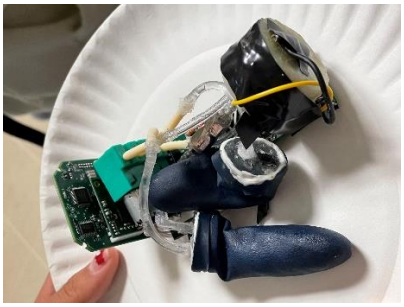
***Experimental Goals:***

The goal of the experiment is to measure the difference between the magnitude and duration of the voltage output of a microbial fuel cell on earth compared to one in microgravity. In a world with an increasing demand for new energy sources, microbial fuel cells show huge potential as a renewable energy source.

***Challenges/Solutions:***

A primary challenge with this experiment was the inability of their initial test chamber to carry a voltage across it. In order to analyze why the test chamber failed to operate as expected, they utilized a dremel to open the test chamber and identify any issues. The primary issues entailed an insufficient quantity of C6N6FeK3 (aq) and an insufficient amount of bacteria on the graphite felt. In order to remedy these concerns, they adopted a new strategy to better fill the chamber with C6N6FeK3 (aq) and ensured the bacteria was sufficiently adhered to the graphite felt. Upon

implementation, the new chamber carried an expected voltage and operated within expected parameters.



experimental set up

Next Steps: Their experiment's launch date is scheduled for early May, 2022. They expect to receive results by late June.