# CALIFORNIA SCIENCE & ENGINEERING FAIR
## 2018 PROJECT SUMMARY


**Name(s)**

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**Project Number**

38464

**Project Title**

# A Rising Power: Improving the Power Output of Microbial Fuel Cells, a Solution to Our Quest for Renewable Energy Sources


**Abstract**

**Objectives/Goals**

As global warming increases and an energy crisis looms, microbial fuel cells (MFC) offer the promise of clean, renewable power. After studying MFC design and function, how do different substrates, electrolytes in the cathode, temperatures, and nutrients in the anode impact power output of a MFC? Using mud from San Mateo creek and Bay wetlands, bay glucose MFC will produce maximum power because anaerobic bacteria will thrive with an enriched energy source.

**Methods/Materials**

Mud was collected and sifted from San Mateo Creek and Bay wetlands. 8 MFCs were built using a single cell design with a plastic container and mud sandwiched between a cathode and anode graphite discs. 5g of glucose was mixed with both mud sources. Once closed, a hacker board connected the external wires to the MFC. For the environmental temperature variable, a bay and creek MFC was maintained at a temperature of 28 deg C (controls, 18 deg C). 8 MFCs were allowed to reach power output equilibrium after 1 week. Conductivity of mud samples was measured and 5g of salt added to the cathode side of the MFCs. Power output was measured using 7 different resistors by measuring voltage of the MFC and calculating power (V2/R) in microwatts (uW). All MFCs were measured with 7 different resistors every other day until the power output declined. Analyses and graphs were performed in MS Excel.

**Results**

By far, the MFC that produced the most power output was the 'bay glucose' MFC: max power 5.75 uW, day 5. Bay mud had the highest conductivity and the added salt increased the conductivity 100-fold. The lowest internal resistance was bay MFC at 47 ohms, day 5. All creek MFCs produced little to no power regardless of changes.

**Conclusions/Discussion**

The 10-fold power boost for the bay glucose MFC was due to added nutrients enhancing bacterial performance. Power decline observed across MFCs in the last 2 trials may be a result of MFCs depleting the nutrient supply. Creek MFCs produced little power likely due to the cleanliness of the ecosystem. Testing multiple resistors demonstrated that the internal resistance of all the MFCs was abnormally high. This means that the MFCs lost a significant amount of power that could have been transferred to an external load. Future experimentation with MFCs could include using mud from bacterial-rich sources, altering glucose/salt quantities, and building 2-chamber MFCs to improve lifespan.


**Summary Statement**

I tested how different substrates, electrolytes in the cathode, temperatures, and nutrients in the anode impacted power output of a microbial fuel cell.


**Help Received**

My parents bought the supples and drove me to get the mud.