3e.

Logbook

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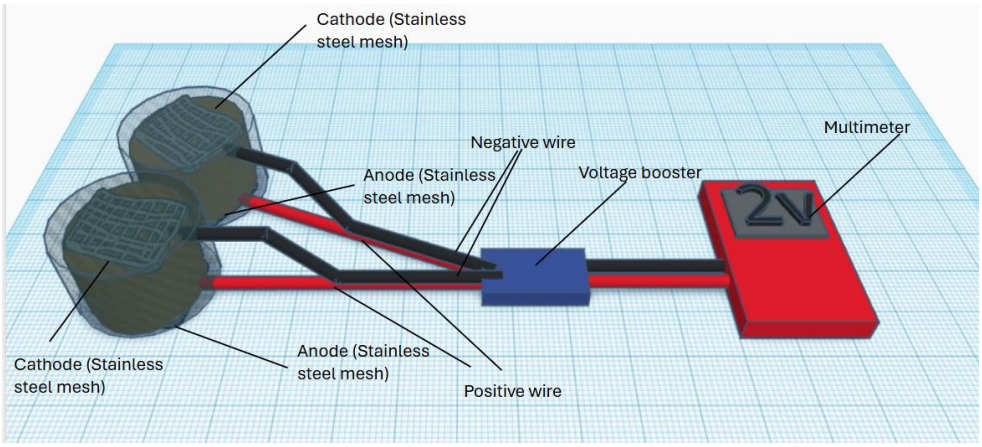
Grade: 9

Project: How can we fully utilize microbial fuel cell technology to power remote villages?

Date	Notes:
October 4 2024	Met with Ms. Bretner and had question approved. Question: How can we fully utilize microbial fuel cell technology to power remote villages? Type of Project: Innovation
October, 29	Went through experimental/innovation/study rubric to understand components of project.
November, 5	Started to find our issue - Lack of electricity in rural areas. How can we optimize microbial fuel cell technology to create renewable energy in remote villages. As well as the fact that microbial fuel cell technology doesn't produce much voltage. Testable Question - How can we use microbial fuel cell technology to create renewable energy in remote villages. Looked for and created several designs for low-cost microbial fuel cells

	
November, 16	**We wrote 2 Background Slides, talking about the topic of MCF and the key components located inside of this machine. This helped us get a clearer understanding of what a MCF is and how it functions.** What are Microbial Fuel Cells ➢A microbial fuel cell is a bio-electrical system that converts chemical energy into electrical energy. This is because the reactions catalyzed by microorganisms result in electrical energy. ➢A microbial fuel cell consists of an anode and cathode a polymer electrolyte membrane which is a made of polymer perfluoro sulfonated acid and is used as the electrolyte. ➢Bacteria thrive and multiply on the anode, generating a dense cell accumulation called biofilm that sticks to the anode of the microbial fuel cells ➢Bacteria then use their microbial metabolism to transform organic substrate into CO_2, electrons, and protons

	Parts of a Microbial Fuel Cell Anode – Is the positively charged electrode and the electrode where electricity moves into Cathode – Is the negatively charged electrode and the electrode where electricity given or leaves PEM – (Proton Exchange membrane) Is designed to conduct protons while acting as an electronic insulator and generally made from ionomers which selectively transports protons from anode to cathode Microbes – Is the substance that breaks down the substrate, releasing electrons, protons, and CO_2 Substrate – The substrate is the organic material that the microbes consume to generate energy. The microbes break the substrate down and release protons, electrons and CO_2 Electrolyte – Supports the growth of microbes by providing a liquid environment. Conducts ions between anode and cathode chambers to maintain a charge balance throughout the process of producing electricity Aeration Device – Is used to supple the cathode with oxygen which improves the cathode reaction rate, enhancing the overall power output of the fuel cell. External Circuit – Allows electrons to flow from the anode to the cathode, generating an electric current. Consists of conductive wire, resistor and a Multi-Meter
November, 30	**Finalized the materials that we would be ordering to create the MCF. These links are from Amazon and Walmart.** **Things we need to buy** Stainless steel mesh - https://www.amazon.ca/Stainless-Screens-Material-Hardware-11-81x39-37in/dp/B0DD7333F7/ref=sr_1_2_sspa?dib=eyJ2IjoiMSJ9.hRMKwZf6ZJoL5Q6TTNbWxdE0WBMHtdjuMh21ckETWp68NY0DGj8z4ENCbkSCOKPjblTG4MlRSjRqplhJ1QjPBwFMV-PIW6on4HS2QP2lShvRUKDjjembLBB0lIdpUeHH1ljwVTB-X3BewPtCLOl5jWrLO2gXPhX-SDsA0jMAZvT1u2P90xJNy8xF28GBtNTLtCeMEelDvS88Ji8UT2Js18D9FSQGgc7tYncJBzYVYTGeaLdQQIjqDAdfV1SIJyvZ_H2ho6lkXNkGZcF1ByX_QU_Ftw9M2LmEBj6QwedW3ml.eOmpsEuDODcm2pG8T_mpMtVJ8Na09j6RR7HzYzMQHjU&dib_tag=se&keywords=steel%2Bmesh&qid=1733012718&sr=8-2-spons&sp_csd=d2lkZ2V0TmFtZT1zcF9hdGY&th=1 Activated Carbon (Activated charcoal) - https://www.walmart.ca/en/ip/aqua-tech-activated-carbon-aquarium-filter-water-cleaner/6000201643070offerId=6000201643070&storeCode=1049&cmpid=SEM_CA_48326_9RG1YP6HNF&utm_id=SEM_CA_48326_9RG1YP6HNF&utm_medium=paid_search&utm_source=google&utm_campaign=always_on&gad_source=1&gclid=EAIaIQobChMIqND0-aeFigMVFDWtBh08ihpYEAQYASABEgLVSPD_BwE&gclsrc=aw.ds Electric Wire - https://www.amazon.ca/dp/B08F7F6PH4/ref=sspa_dk_detail_4?pd_rd_i=B08F7F6PH4&pd_rd_w=WHi8O&content-id=amzn1.sym.516c2169-755e-413e-a38e-68230f4ab66f&pf_rd_p=516c2169-755e-413e-a38e-68230f4ab66f&pf_rd_r=T8V5GWJY5MA02EZA4Y4V&pd_rd_wg=aOzRS&pd_rd_r=a54aedb9-821b-4538-917f-6ab46d2b053c&s=hi&sp_csd=d2lkZ2V0TmFtZT1zcF9kZXRhaWw&th=1 Epoxy Glue - https://www.amazon.ca/Gorilla-4200602-Epoxy/dp/B07W6C9R4K/ref=sr_1_2_sspa?crid=14493XNXD9KD8&dib=eyJ2IjoiMSJ9.EMPBaBs_NFW24V2CJFEs7cDJeWTuM2-k0uqJd0yuv12c6-LlmeuKqcrvpgNetPix1hJ4bsQIKkf1ahPHZ-d_Zupqy1jaGoP8Cx9P-4JvTZV9COam2715fsV3vs5e8FvOCrJWbr53OevGwFdPuJ2eVPNxa23krgUW4kxtbZx-vOsamYNPK5VlwcXrtL_Bc1Kv5akZr73VWviXeSilZiqe2d68fMMjyEpp-GcrLSm-KOUUWWKZ7OK8ChQgNU5NQ-mVeQ3KFziWAzr81G-83NqZqn7ACSQamvpLGOP-f4tSpk.5eB3Y-Ywez-N1_4VhhkO2UUOX4fBCw3DeYZv0abH6hI&dib_tag=se&keywords=epoxy%2Bglue&qid=1733013194&s=hi&sprefix=epoxy%2B%2Ctools%2C143&sr=1-2-spons&sp_csd=d2lkZ2V0TmFtZT1zcF9hdGY&th=1 Thick Rope - https://www.lowes.com/pd/Blue-Hawk-0-75-in-Twisted-Sisal-Rope-By-the-Foot/1000760440 Boost Converter (higher voltage) - https://www.amazon.ca/DEVMO-Voltage-Regulator-Converter-MT3608/dp/B09X7G2Z1F/ref=sr_1_1_sspa?crid=1KVC8RPY9H40U&dib=eyJ2IjoiMSJ9.FIB7mQYsWIFgIp14PCkPNaPP7U7IpiDdk3MrEnB6p9YNkj6qnQAiP9kmkBZfh37tXUxiI93hIQF5mXe6a2kqh_hIIdUE51Qrh8lZRnLxXHFVR207DvNpVM7MXXdavbGzwMkJgxQxQdckNyRqWhV_LaG-Na3vv3tyxpSHjJcFFwpcWlfIKdyeGtl-rHGWb2RiKGf2LVdvKqC4dVIEEuPE_6Vi431ndTfY5sAq6SfjW6C01PuW9JZ0sgF-pScLFYRP1tstvPlZFVHI_CHX7F5kp0fxnglsqpOw032IaN44KAA.JrHUDhrPrbvQW9Pvzj38YRiPQnjsu2dxGvcgfaKVp30&dib_tag=se&keywords=Boost+converters+2v&qid=1733012357&s=industrial&sprefix=boost+converters+2v%2Cindustrial%2C127&sr=1-1-spons&sp_csd=d2lkZ2V0TmFtZT1zcF9hdGY&psc=1#customerReviews
December 3, 2024	**Today we did some more background research, we wrote about why microbial fuel cells should be used and the history of them.**

	## Why use Microbial Fuel Cells? • MFCs offer great promise for the future, as they can generate electricity while resolving environmental issues • Their versatility makes them very suitable for use in both urban and rural locations, especially those with limited electricity (Rural Villages) • Unlike fossil fuel-based traditional power generation system, MCFs emit a small amount of greenhouse gas ## History of Microbial Fuel Cells • Microbial Fuel Cells have been around since the early 20th century. • Initially, M.C. Potter designed the first microbial fuel cell in 1911, it wasn't refined and lacked attention, he ultimately scrapped the design. • The MFC regained attention in the 1970s, with studies and tests being held. • We want to make MFC's affordable and design MFCs that can be made in a bigger scale for remote villages.
December 15, 2024	**Today we made our actual fuel cell.**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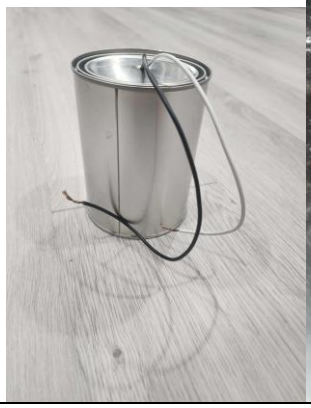
10 MEG Ω IN PUT IMPEDANCE
10 MΩ IMPÉDANCE D'ENTRÉE
DCV
CCV
1000
200
20
2
POINT
HORS
CIRCUIT
OFF
500
ACV
CAV
200
20
2M
200K
20K
2K
Ω
OHM
200
1.5V
BATT
PILE
9V
2mA
20mA
200mA
10A
DCA
CCV
2.8V MAX TEST VOLTAGE
TENSION D'ESSAI 2.8V MAX
10A
15 sec max / 30 min
CERTIFIED



	
December 24, 2024	**Today we worked on 3 slides about how the fuel cell can be improved and complications with the MFC.**

Complications

Although microbial fuel cells offer an eco-friendly, and simple way of generating electricity, multiple problems can arise.

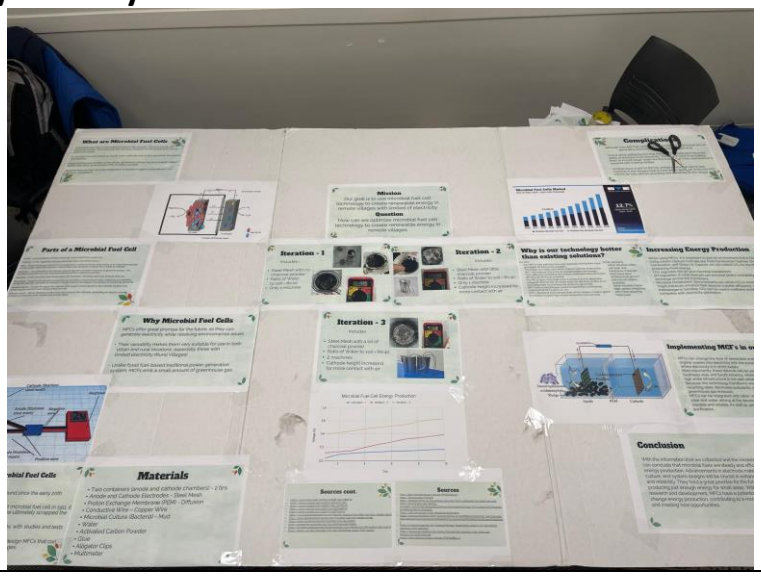
- One of which being the fact that microbial fuel cells don't have the ability to produce much electricity. This can be resolve by making them at a much larger scale, but this means that more maintenance is required with it being costlier.
- Another issue could be the low energy production due to less nutrients in the villages mud or food waste. Because of this the MCF cannot be fully utilized, providing less electricity to the village

Implementing MCF's in our world

- MFCs can change the face of renewable energy through converting organic wastes into electricity with the purpose of aiding communities where electricity is in short supply.
- Most importantly, these devices will be useful in Sub-Saharan Africa, Southeast Asia, and South America, where production of organic wastes is high while infrastructure is not well advanced.
- Because this technology transforms waste into energy, it increases recycling rates, decreases pollutants, and in the process, minimizes greenhouse gas emission.
- More research and cooperation could allow MFCs to play a significant role in improving clean energy access worldwide.

Future Directions

- Increased amount of studies should be held on MFCs to upscale energy output and cost efficiency for large scales such as poverty-stricken areas.
- MFCs can be integrated with other renewable energy sources such as solar and water aiming at the development of hybrid systems that are capable and reliable. As well as, performing other tasks such as water purification.
- With further innovation, MFCs could play a pivotal role in shaping the future of clean energy.

January 17, 2025	**Today we finished 1 slide on how Microbial fuel cells are greater than traditional methods.** Why is our technology better than existing solutions? Some benefits of MFCs with the existing energy options include: - That it is a renewable source of energy at lower costs and more environmentally friendly; whereas old fuel cells depend on very expensive catalysts. - The breakdown of organic material in MFCs into electrical energy depends on naturally occurring microbes, which means they will be even cheaper and more renewable. - Moreover, MFCs are able to generate electric energy from wastewater and other organic wastes, thus turning the pollution into a useful energy source while simultaneously the waste treatment is performed. - MFCs are much more environmentally friendly compared with the traditional batteries since they do not depend on any limited resources and do not generate hazardous waste. - With this, it is a good alternative to the basic ways of harnessing power in most remote, off-grid areas where hardly any infrastructure is found. As these continue to evolve, MFCs could change the face of clean energy production and wastewater management unlike anything that has previously been developed. - Ours is more cheaper, more flexibke, uses renweable materials – foodwaste, mud
January 29, 2025	**Went to go print completed slides for our trifold**
February 5, 2025	**Today we fully built our trifold with all the slides.** 
February 16, 2025	**Created our pitch/script.**
February 19, 2025	**Project Complete**

SCIENCE FAIR LOGBOOKS

Every science fair project **must include a logbook**, also sometimes called a research notebook, which is a complete, permanent record of how you did your experiment/research project; it shows what you did and thought every step along the way.

LOGBOOK POINTERS:

- write your logbook in a notebook
- make an entry every time you work on your project
- date each entry
- make your notes in point form
- don't worry about neatness; you do not need to re-copy your logbook to make it look "tidy"
- organize your logbook into sections such as: schedule, daily notes and ideas, background research, contacts and references, experimental procedure/method, data collection sheets, observations/results in tables and graphs, conclusions
- Write everything down, even if it seems insignificant at the time; the information may be useful later on
- Make sure that you describe things in enough detail that you and anyone else reading your logbook in the future will be able to understand your thoughts and repeat the entire experiment exactly like you did it in the first place, just using your logbook.
- You must create your logbook as you go; it is unacceptable to create your logbook on the computer after you have finished your project
- NOTE: The text that appears on your backboard/tri-fold is just a summary of what you write in your logbook; there is much more information in your logbook than what appears on your backboard/tri-fold.

LOGBOOK CONTENT:

- **Timetable :** Come up with a timetable for doing each of the steps of your project and try to stick to it
- **Choose a Topic**: make a list of topics that interest you, things that you are really curious about and that you want to find answers to; explain how you came up with your topic, why you decided to do it.
- **Background Research**: Record your background research about your topic from books, magazines, TV programs, the Internet (with supervision), people and companies. Keep a record about where you gathered your information for your bibliography/list of references and acknowledgements.
- **Testable Question/Purpose:** Based on your background research, write down your testable question/purpose

- **Hypothesis**: write down what you think the results of your experiment will be based on the research that you've done
- **Materials:** List everything that you will need to do your experiment, such as equipment, ingredients, quantities of ingredients, measuring tools etc. Be very specific – give lots of details
- **Procedure**: List the steps you will go through to do your experiment. If you make any changes to the procedure after you start your experiment, describe them in your logbook with an explanation about why you made the change(s) and if the change(s) will affect the results collected prior to the change.
- **Variables**: list the controlled variables, the manipulated variable, and the responding variable
- **Data:** record all of your measurements/raw data that you collected on data sheets in your logbook
- **Results:** record your collected data in charts, tables, graphs, pictures and use these to help you explain what happened in your testing; describe any problems you might have had while you were testing , any changes that you had to make to your original plans, and whether those changes would affect the results collected before you made the changes
- **Conclusions:** write down your conclusions, whether or not your hypothesis was correct and why. It is OK if your results do not support your hypothesis - the information you collected still supports science.
- **Recommendations/Applications**: Make recommendations for improving your project, for further study, and applications I can make from my research