

Microbial Fuel Cell Experiment

Daily Required Materials

- Teacher/students' HP Stream & projector
- BasicBoard
- Student notebooks

Lesson 1 Starter Experiment

Additional Materials

- Follow directions to assemble the MFC experiment which includes a “MudWatt” microbial fuel cell (MFC) and sensors to monitor internal and external temperatures.
- Describe how the MFC experiment components and BasicBoard system work together to gather power and temperature information.
- Understand how Logo collects and displays measurements from the MFC experiment.
- Describe any patterns you see in the initial data from the MFC experiment.

- 2 Leashed and wrapped temperature sensors
- Needle nose pliers
- Wire as needed
- Wire stripper
- Anode pad (thin) + green titanium wire
- Cathode pad (thick) + orange titanium wire
- MudWatt vessel from Keego Technologies LLC (lid predrilled)
- Hardware baggie containing 2 nylon bolts, 2 nylon nuts, 2 nylon washers, 2 crimp connectors.
- Small amount of modeling clay
- Pencil
- Plastic container
- Cup of water
- Spoon
- Screen or sifting device
- Soil (dry)
- *Optional:* pinch of salt, pinch of sugar, and shredded thin paper to add to the soil

Lesson 2 Models and Questions

Models and Questions A - *Modeling the MFC Circuit*

Additional Materials

- Create a diagram that traces the flow of electrons within the MFC experiment circuits.
- Explain the structure and function of the MFC experiment circuits.

- Worksheet: Models and Questions
- Starter Experiment

Models and Questions B - *Soil and Bacteria*

Additional Materials

- Describe what evidence is needed to answer your scientific question.
- After reading Shewy The Electric Microbe, investigate how various microbes may interact within soil samples.
- Create a model that depicts how electrogenic bacteria interact with their environment in a microbial fuel cell.
- Use graphical representations of MFC data to infer details about microbe populations and soil conditions.

- Worksheet: Models and Questions
- Comic Book: Shewy the Electric Microbe
- Saved soil sample from Lesson 1
- Magnifying glass
- Sorting tray or large sheet of paper

Models and Questions C - *Ecosystems and Energy*

Additional Materials

- Identify relationships between producers, consumers, and decomposers in ecosystems.
- Create and refine a model food web of your MudWatt vessel's ecosystem.

- Worksheet: Evidence and Interpretation
- Starter Experiment

Models and Questions D - *Powering the Microbial Fuel Cell*

Additional Materials

- Use Ohm's law to calculate current, voltage, and power for various MFC configurations
- Estimate the size of an MFC microbe population based on MFC power output

- Worksheet: Evidence and Interpretation
- Starter Experiment
- Digital multimeter

Microbial Fuel Cell Experiment *(continued)*

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Lesson 3 Investigation Plan

Additional Materials

- Describe what evidence is needed to answer your scientific question.
- Design an investigation and explain how this investigation will generate relevant patterns of evidence to answer the scientific question.
- After peer review of the scientific question and the investigation plan, revise the plan to increase relevance to your question and to generate data that is more accurate and more precise.

- Worksheet: Investigation Plan
- Starter Experiment

Lesson 4 Evidence and Interpretation - *Modeling the MFC Circuit*

Additional Materials

- Organize, represent, and analyze data from the investigation.
- Assess whether or not the data collected is sufficient evidence to answer the scientific question.
- Revise your microbial fuel cell model and explain how this new model is a better fit for available evidence.

- Worksheet: Evidence and Interpretation
- Starter experiment

Lesson 5 Presentation

Additional Materials

- Create an evidence-based account of the investigation process and the answer to the scientific question. The format is selected by the instructor and may be a laboratory report, presentation, poster, video, model, etc.

- Refer to daily required materials