

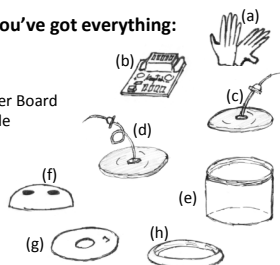
Congratulations! You're the proud owner of a MudWatt™ Microbial Fuel Cell. Let's get started:

Note: Wear your gloves (included) while constructing the MudWatt™. Please read the disclaimer at the end of this booklet to see why.

Prepare Your MudWatt™

1 Make sure you've got everything:

- a) Nitrile gloves
- b) MudWatt™ Explorer Board
- c) MudWatt™ Cathode
- d) MudWatt™ Anode
- e) MudWatt™ Vessel
- f) Dome Lid
- g) Donut Disk
- h) Sealing Ring



11 Place the Cathode gently on top of the mud

Hint: Be sure not to cover the cathode with any soil or liquid. Let the soil rest for a few minutes and drain any excess liquid.



Wipe off any mud on the rim

12

13 Put on the Donut Disk+Dome Lid and screw on the Sealing Ring



2 Connect the Cathode

- Place Cathode (red) wire through donut disk (with tab facing away from Cathode)
- Plug rubber bumper into Dome Lid



3 Connect the Anode

- Place Anode (green) wire through donut disk (with tab facing away from Anode)
- Plug rubber bumper into Dome Lid



4 Twist wires together one full turn



5 Put on Ruler Sticker

Line up the top of the sticker with the edge of the Vessel.



Prepare Your Mud

6 Find some soil

You can either dig it up from your backyard (or someone else's backyard), or you can purchase it at a store. However, avoid soils with little white balls in it because those will aerate the soil, which is bad for the anode.



7 Mix in water until it feels like cookie dough

This consistency is very important. If it is too crumbly, add more water. If it is too drippy, add more soil.



Want to add a mystery ingredient? Check out our Community page for further instructions at: www.keegotech.com/community/education

Feed Your MudWatt™

8 Fill Vessel with Mud up to 1cm line

Pat down smooth.



9 Place the anode on top of the Mud

Make sure there are no air bubbles under the Anode.



10 Fill Vessel with Mud up to 4cm line



14 Attach Explorer Board

Use the included hook and loop disks to attach it to the top or the side.



15 Plug electrodes into the Explorer Board



Hint: Anode (green) plugs into the "-" port and Cathode (red) plugs into the "+" port.

That's it!

Your MudWatt™ Microbial Fuel Cell is complete. Watch it grow more powerful in the coming days as electrogenic microbes develop! Turn on Nob#1 on the Explorer Board to see your microbes in action.

What to expect:

Depending on the temperature and the soil conditions, it should take 3-10 days for the MudWatt™ to develop enough voltage and current to blink the blinker. You can expect your MudWatt™ to produce approximately 100uW with just topsoil and water (however, all soils are different). As long as the MudWatt™ is tightly sealed, and it remains moist, this power will last for years!

****Disclaimer:** The MudWatt™ electrodes are made of graphite fiber, which is a conductive material and will cause shortages when in contact with electronics. Do not to place the electrodes near electronics or power plugs and use care not to disperse fibers into the air.



Build Your Mudwatt™



This paper is Green Seal and Green-E Certified



Special Ingredient Instructions

Ah, so you've decided to add a special ingredient to your MudWatt™. Very Bold! We at KeegoTech commend you for your bravery! With your ingenuity, we can really catalyze the development of MFC technology together.

Here, you will find basic instructions and hints aimed to help you maximize your success with your MudWatt™. Enjoy!

Preparing Your MudWatt™ Fuel:

- 1) Find some soil

Hint: You can either dig it up from your backyard (or someone else's backyard), or you can purchase it at a store. However, do not use soil with little white balls in it! These little styrofoam balls are great for helping plant roots breathe, but they are bad for your MFC.

- 2) Find some special ingredients

Hint: These can be anything you find in your refrigerator, a compost bin, or anything else you find outside. Think, if you were a microbe, what would you want to eat?

- 3) Prepare your MudWatt™ fuel by mixing your soil and special ingredients

Hint: Record the volume fractions of the soil and the special ingredient (you will need these later when you share your data). For special ingredients that are solid, we recommend a ratio of about 3 parts soil to 1 part special ingredient by volume. For special ingredients that are liquid, we recommend mixing it into the soil until you reach "cookie dough" consistency.

- 4) Add water or soil as needed to get "cookie dough" consistency.

Hint: This consistency is important. If it is too dry, add water. If it is too goopy, add more soil.

Awesome! Now you can continue with the instructions in your "Build Your MudWatt™" booklet. Be sure to submit your MudWatt™ data at www.keegotech.com/community/datashare and take your place among the Keego Community. All hail the Keegoites!



MudWatt™ Hacker Board

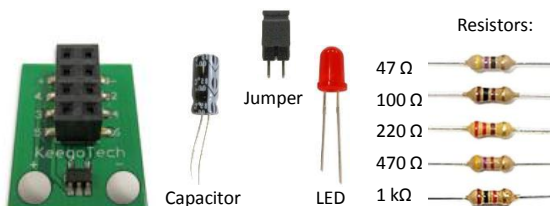
User Guide



This paper is Green Seal and Green-E Certified

Getting Started:

Make sure you've got everything:



MudWatt™ Hacker Board

If you're curious how all the components of the Hacker Board work, please visit our forum at: keegotech.com/forum.

Blinker Mode:

- 1) Connect the MudWatt to the first two pins on the Hacker Board (Cathode (red) to '+' and Anode (green) to '-').
- 2) Connect pin 1 to pin 2 using the jumper.
- 3) Connect the Capacitor's long end to pin 3 and its short end to pin 4. You may need to bend the wires so that they fit snugly.
- 4) Connect the LED's long end to pin 5 and its short end to pin 6. You may need to bend the wires so that they fit snugly.



That's it! You should start seeing the light blink after a few days, once your MudWatt has developed a healthy community of microbes!

Hacking the MudWatt:

We encourage our customers (the Keegoites) to use the Hacker Board to experiment with powering other devices. For ideas on different hacks or to submit your story of your own hack, please visit our forum at: keegotech.com/forum.

Maximizing Power: The Art of Potentiometry

Microbial Fuel Cells (MFCs) generate maximum power when they are subjected to an external resistance that is equal to its own internal resistance. The rest of this booklet will teach you how to find your MudWatt's internal resistance and maximize its power generation using the MudWatt™ Hacker Board.

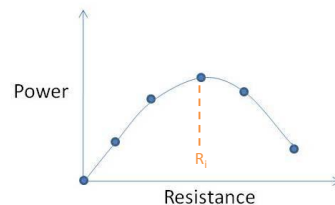
An MFC's internal resistance is a function of the ability of ions to diffuse through the mud from anode to cathode. The lower this internal resistance, the more power the MFC will produce. There are many ways to decrease this resistance, such as adding electrolytes (salts) to the mud.

To find the internal resistance of your MudWatt™, as well as its maximum power output, you will need to perform a technique called "potentiometry" (also referred to as a "Sweep"). This involves measuring the voltage output and calculating the power of your MudWatt™ over various resistances. When you plot your Power vs. Resistance, you will see a power curve as shown on the next page, with the max power being produced at the value of your internal resistance (R_i).

You can calculate the power output by using ohm's law :

$$P = V^2/R$$

P = Power (Watts)
 V = Voltage (Volts)
 R = Resistance (Ohms)



Performing a Sweep:

- 1) To begin the sweep, switch the electronics panel to Open Circuit mode by taking out all components from pins 1 - 6.
- 2) After 30 minutes, check the voltage across the two Test Pads using any voltmeter (black to "-", and red to "+"). Record the voltage and the resistance (the resistance is infinite under Open Circuit mode).
- 3) Place a resistor between pin 1 and pin 4. Step 2 for the 5 different resistors provided with the hacker board.
- 4) Enter the data you've collected at: keegotech.com/community/datashare

Monitoring your MudWatt™:

Watch your MudWatt's power grow and stabilize by performing a Sweep on it every week for the next two months.

Thank You!

With the data collected and submitted by you and your fellow Keegoites, we hope to uncover trends and peculiar behaviors of microbial fuel cell technology. In this way, we aim to catalyze the development of this technology in the hope that someday MFCs will be a viable option in providing affordable and reliable energy for those who would benefit greatly from it. Developed by the public, for the public. All hail the Keegoites!

