

# Microbe-Powered Remote Sensing

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# Outline

- ◆ Who Is This Guy?
- ◆ Context
- ◆ Microbial Fuel Cell (MFC) Principles
- ◆ Some Simple Cells
- ◆ Energy Extraction
- ◆ An application
- ◆ References and Q & A



# Who Is This guy?

- ◆ Area independent consultant and contractor
  - ◆ Software development, specializing in embedded firmware
  - ◆ Simple custom hardware design and prototype fabrication
  - ◆ Specialized Instruction
- ◆ Previously wrote OS, datacomm and compiler/runtime/tools code in regular and embedded settings and learned electronics mostly by osmosis. But give this a try:  
<http://everycircuit.com> !

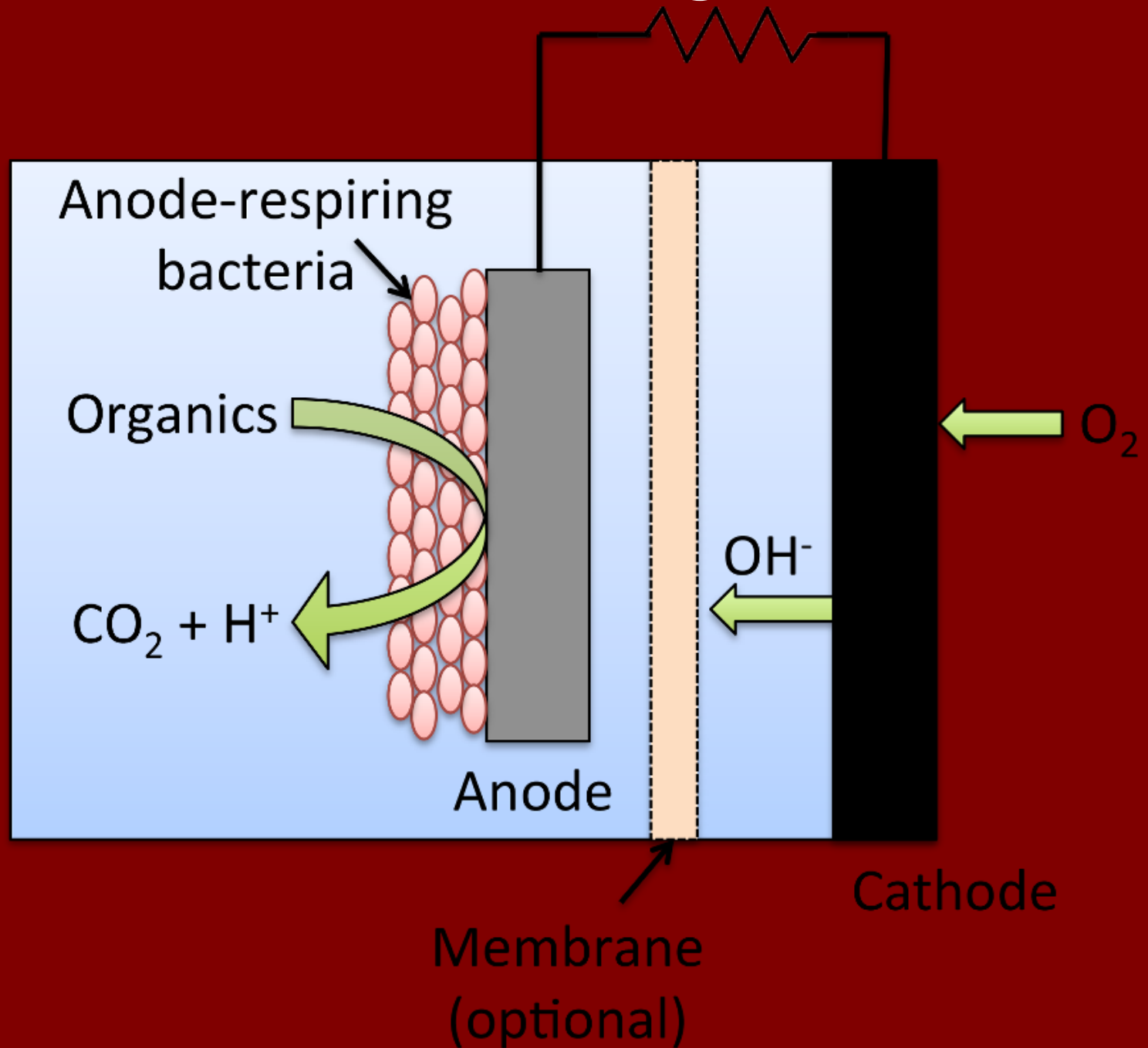


# Context

- ◆ Was adopted as a member of the TriDIYBio organization created by Tom Randall (NIEHS scientist)
- ◆ Dawn Trembath got me interested in microbial fuel cells and we settled on exploring ultra low power and/or long endurance remote sensing applications
- ◆ Made some MFCs to monitor while doing other work
- ◆ Started on energy harvesting and an initial practical application



# Current flows through resistor





# The “organics” I used are anaerobic bacteria in pond mud

- ◆ I have no clue
- ◆ Other TriDIYBio members investigating, doing DNA analysis, etc
- ◆ Not clear what they eat
  - ◆ Something in my mud enjoyed some methyl cellulose for a while, suggesting their friends chopped the cellulose into simple sugars the ‘electron-sweating bugs’ ate
- ◆ Or the metabolism might involve acetates (see first bullet)

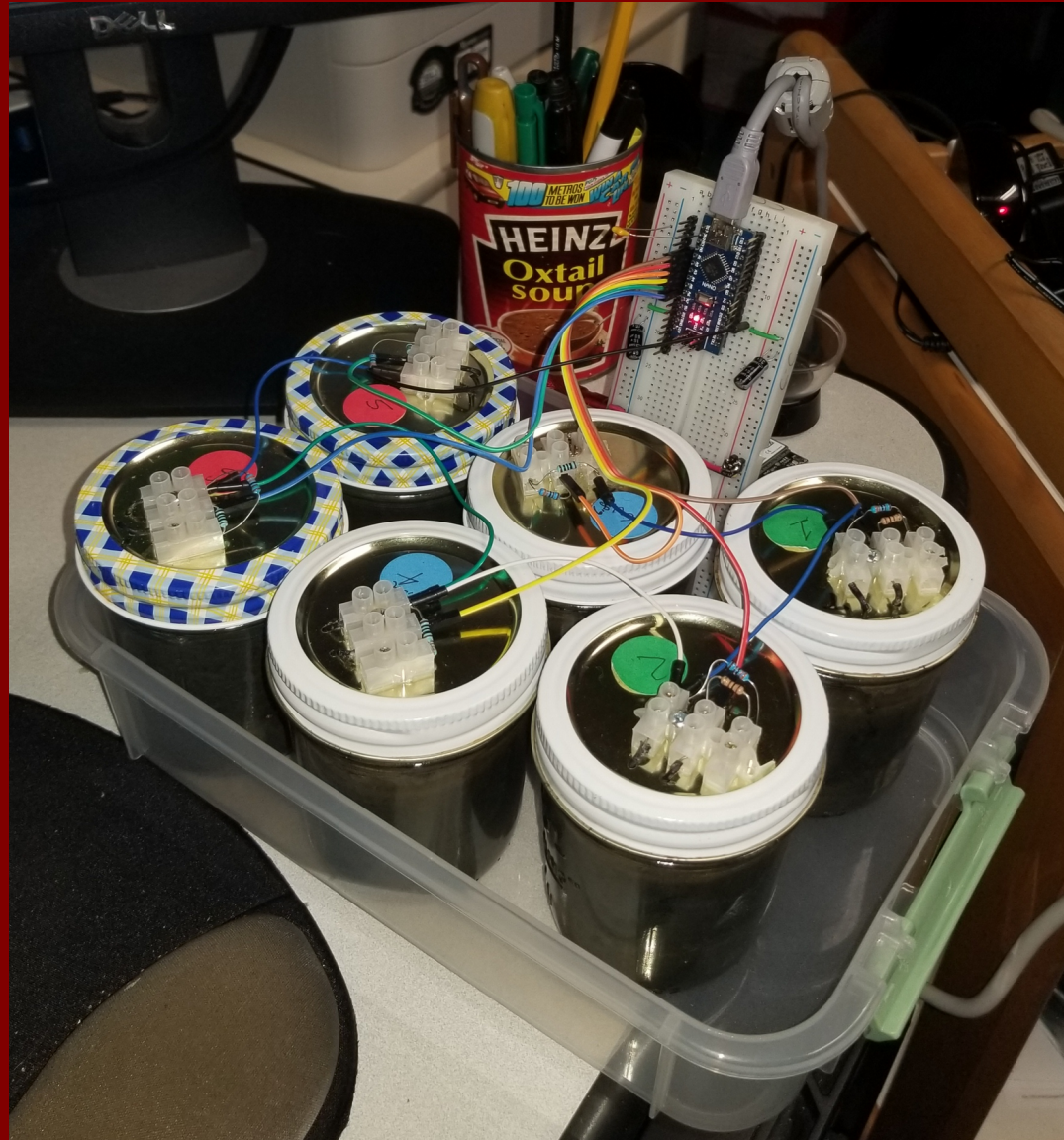


# Components for a simple MFC



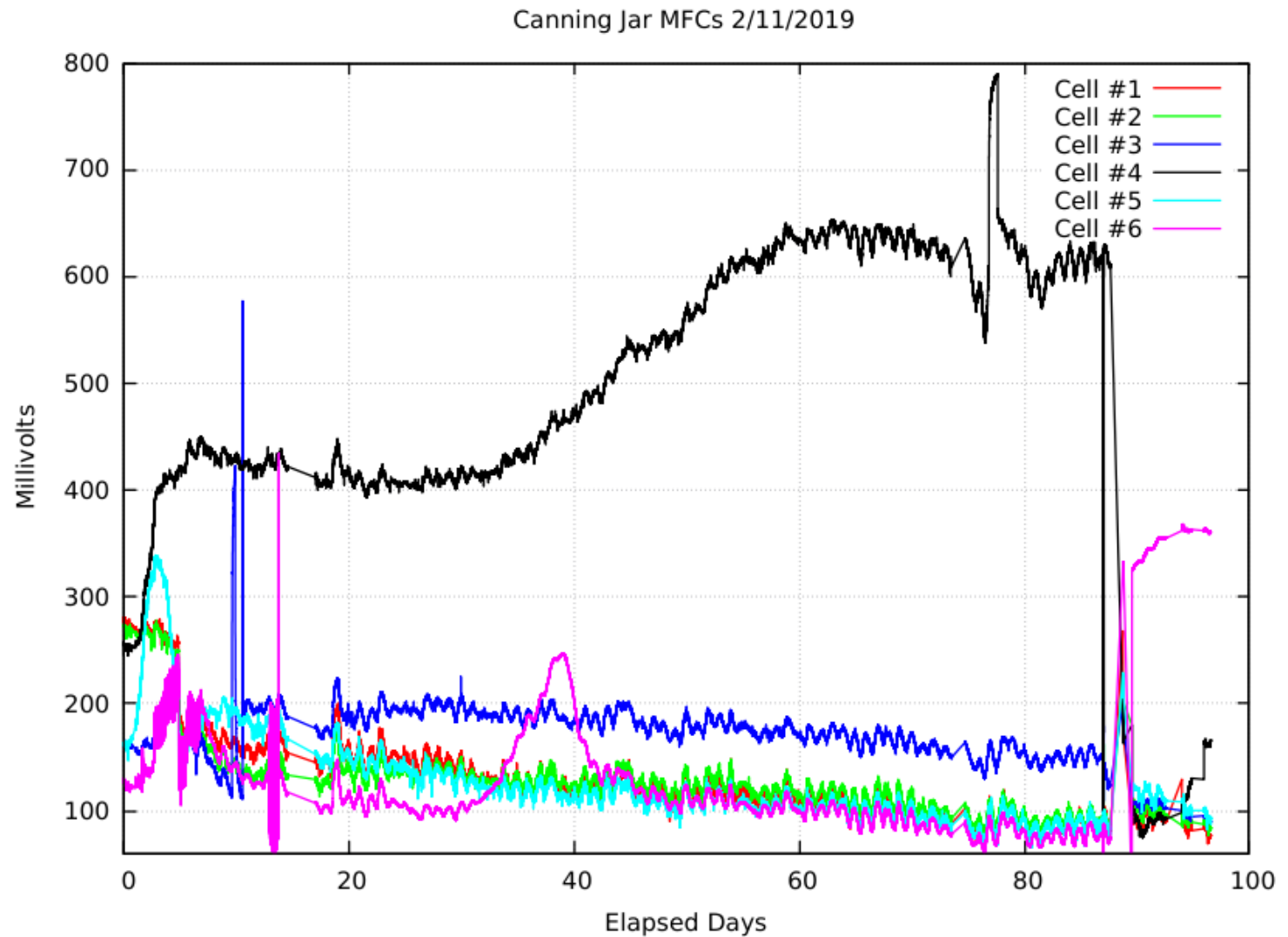


# Canning Jar MFCs October, 2018

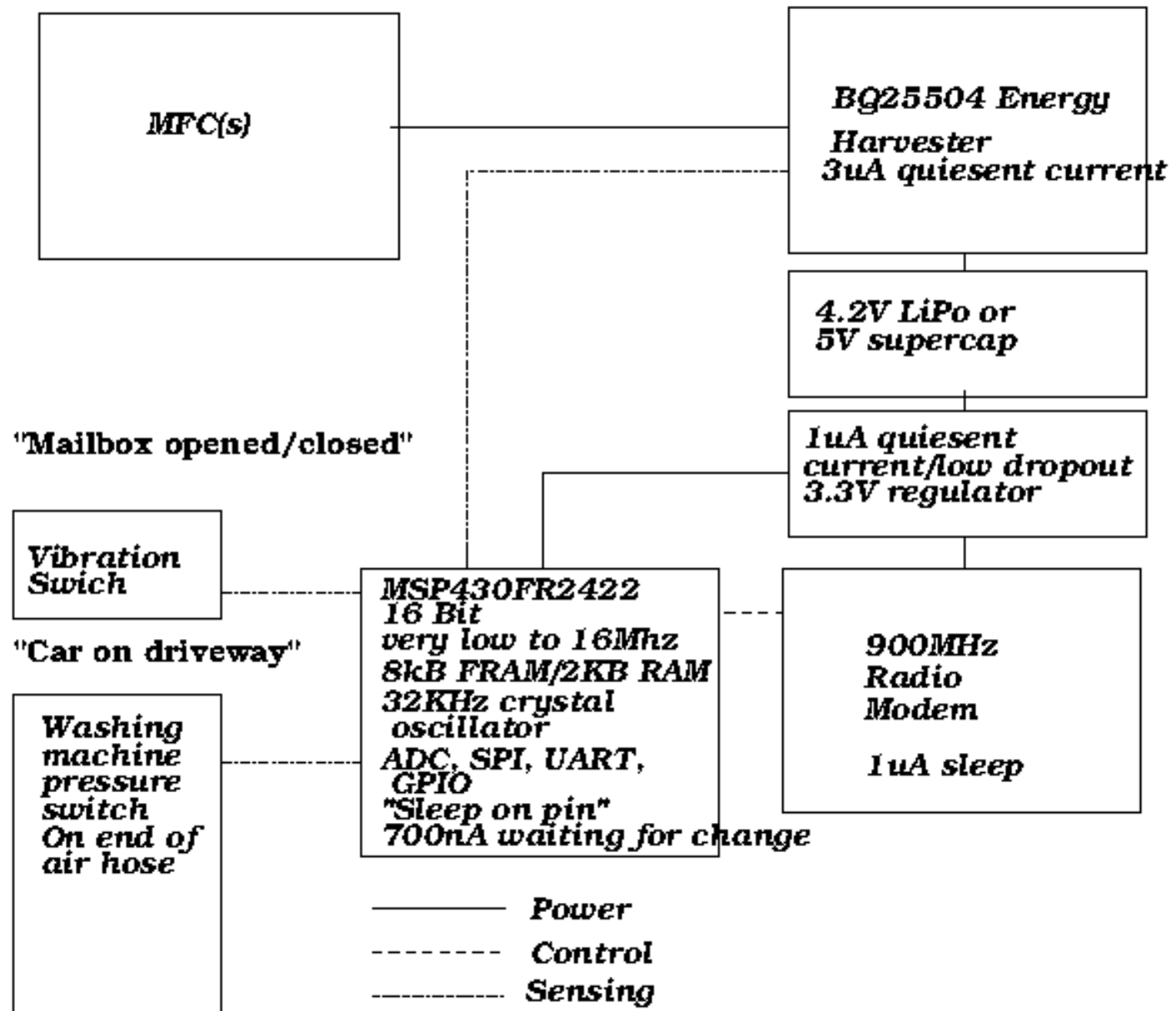




Millivolts per cell across three+ months (All across 3300 ohms except #4 across 6800, mostly)



# Power System and Application







# References

- ◆ Virginia Tech MFC paper using bq25504  
<https://www.sciencedirect.com/science/article/abs/pii/S037877531530152X>
- ◆ An off the shelf MFC with a charge pump blinking an LED: the Mudwatt  
<https://www.carolina.com/environmental-science-soil-studies/mudwatt-microbe-kit/180940.pr>