

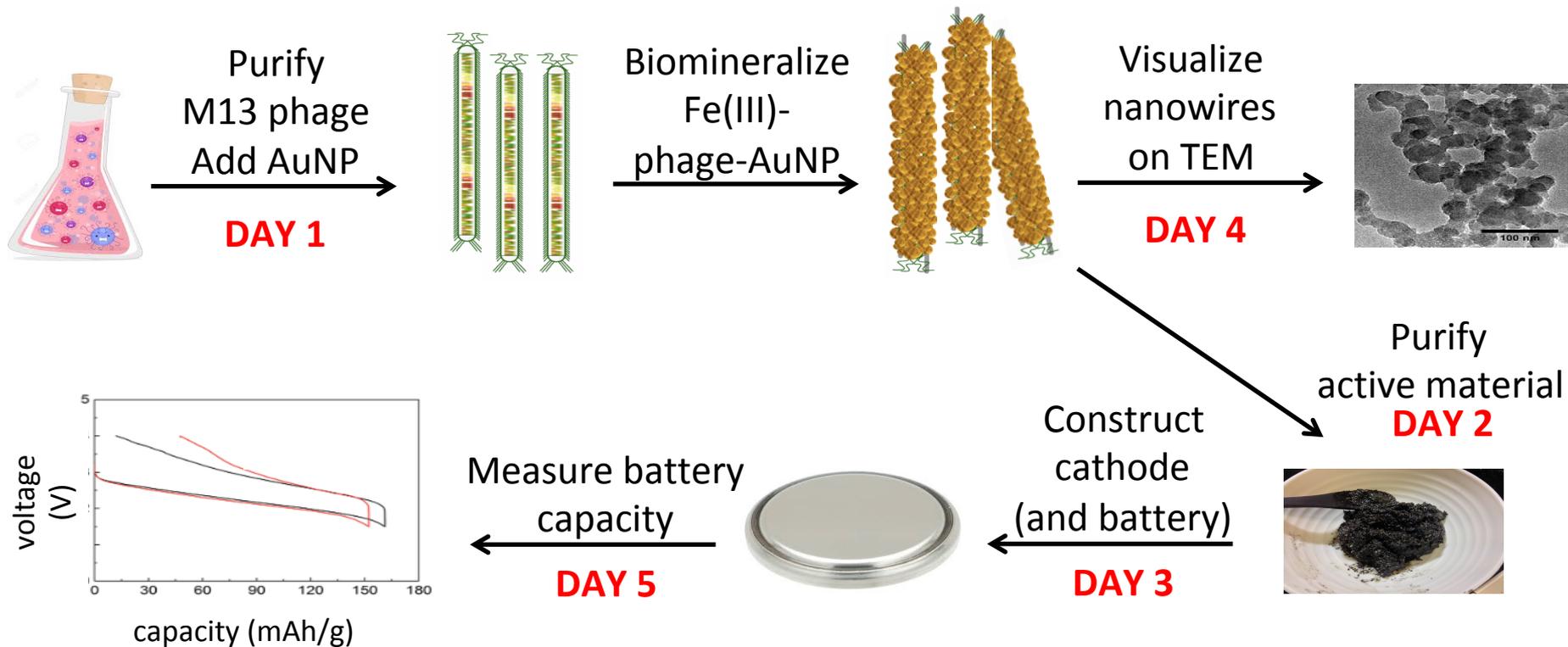
# M3D3:

Construct cathode with phage-based active (cathode) material

1. Quiz
2. Prelab discussion
3. Prepare cathodes
4. Discuss Research proposal ideas



# Overview of Mod 3 experiments



# How do phage scaffolds improve battery capacity?

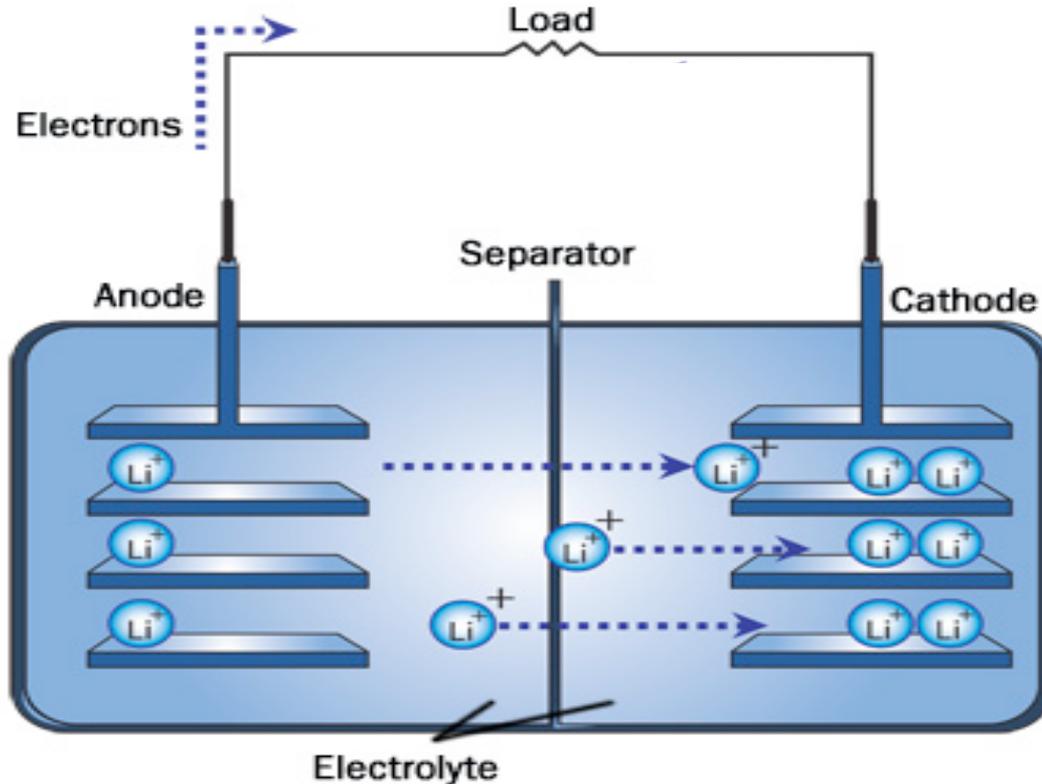
- Ion diffusivity → nano structuring active material
  - What is the advantage of nano structures?

*greater surface area*

- Electronic Conductivity → integrating additives
  - How do phage improve integration of additives?

*modified for binding additives*

# Is this battery discharging or charging?



Anode material(s)?

$\text{Li}$

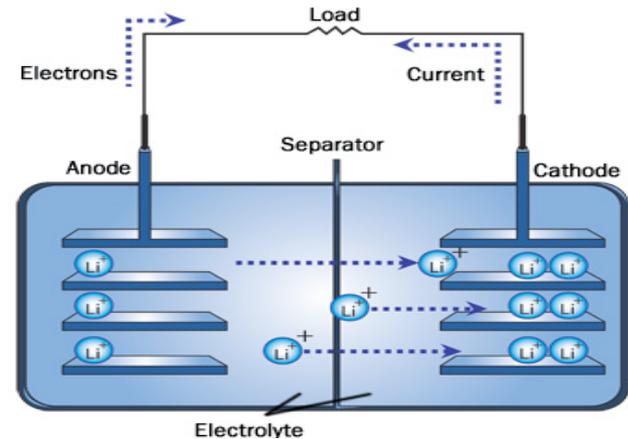
Cathode material(s)?

$\text{Fe(III)PO}_4$   
ANP  
phage

$\text{LiPF}_6$

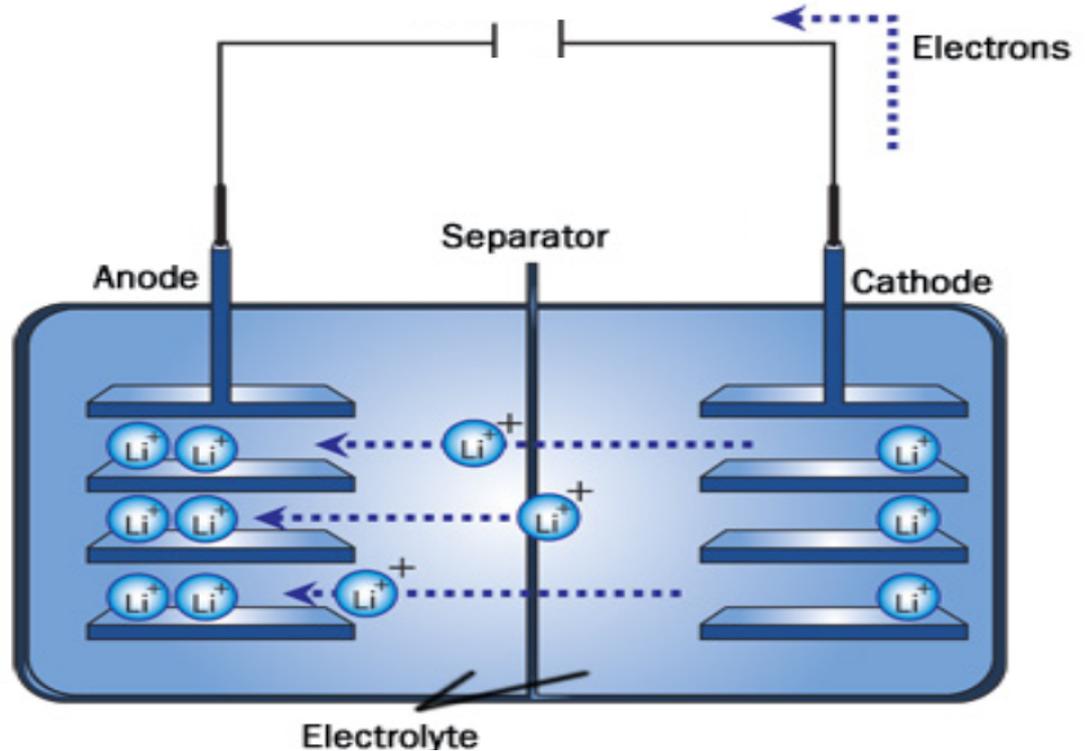
# Cathode is (+) during spontaneous discharge

- Oxidation / Reduction occurs at the cathode (accepts / donates  $e^-$ )
- Oxidation / Reduction occurs at the anode (accepts / donates  $e^-$ )
- During discharge, cathode is positively charged



# During (re)charge, electron flow is reversed

- Charges at electrodes are 'switched'
- Convention is to define cathode according to spontaneous discharge

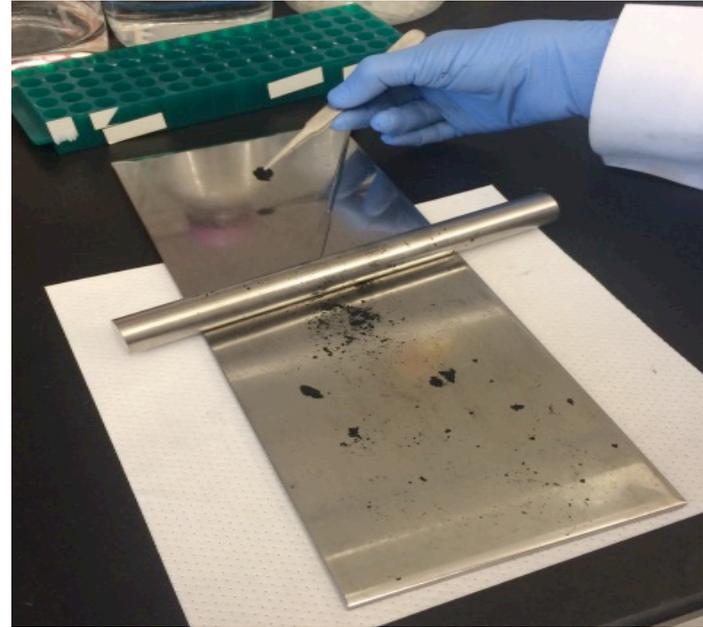


# What is battery capacity?

- Measure of electricity (charge) involved in the electrochemical reaction between the active materials
  - For Fe(III)-phage batteries, theoretical (gravimetric) specific capacity = 178 mA\*h/g
  - Units:  
$$\text{charge/time} \cdot \text{time/mass} = \text{charge/mass}$$
- Capacity calculated from
  - Number of electrons that can be accepted
  - Charge of those electrons
  - Atomic mass
- Why will our batteries not achieve **theoretical** specific capacity?

# How will you prepare your cathode?

1. Weigh AuNP-Fe(III)-phage nanowires (active material)
2. Mix with Super P and PTFE
3. Roll cathode material
4. 'Punch out' cathode disc
5. Weigh cathode (why?)
6. Dry cathode (why?)



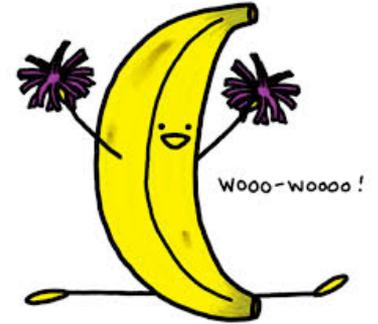
## For today...

- Pack lab coat and goggles for work in Belcher Lab
- Notes from peer review discussion should be included in your laboratory notebook!!
  - Hint: we will likely collect M3D3 for grading 😊

## For M3D3...

- Submit Research proposal outline as team
- Outline Mini-report background / approach as team

# Final major assignment due dates



- Research proposal presentation
  - Completed in teams and submitted via Stellar
  - Due Friday, 5/10 by 1 pm
- Mini-report
  - Completed in teams and submitted via Stellar
  - Due Monday, 5/13 by 10 pm