

M3D1: Growth of phage materials

Meet Jifa Qi & George Sun
from the Belcher Lab

04/15/2016

As you know...

- Office hours this weekend
 - Saturday: 3pm-5pm in 56-302
 - Sunday: 11am-1pm and 2pm-5pm in 56-302
- System engineering research article due 5pm on 04/18
- Blog post(s) due 5pm on 04/19

On the horizon:

- M3 major assignments
 - Research proposal oral presentation (20%)
 - Homework
 - Mini-report (5%)



Use it once

When to use the







MIT **BE**
BIOLOGICAL ENGINEERING

Communication Lab

?

- Prior to M3D2: How do I identify where to start?
- Prior to M3D3: How do I identify what the knowledge gaps are currently in the field?
- Prior to M3D4: How do I identify the holes in my plan?
 By D4 you should be working toward fine-tuning your research proposal.
- Prior to M3D5: Ask for feedback:
 - Will my research plan (methods) answer my research question?
 - What are the expected results?
 - What if I do not get the expected results?
 - What will I learn if I get expected results?
 - What will I learn if I get unexpected results?
- Prior to M3D6 ([presentation day](#)): Ask for feedback on your slides
 - Do my slides convey my message clearly and appropriately?
 - Does my script convey my message clearly and appropriately?

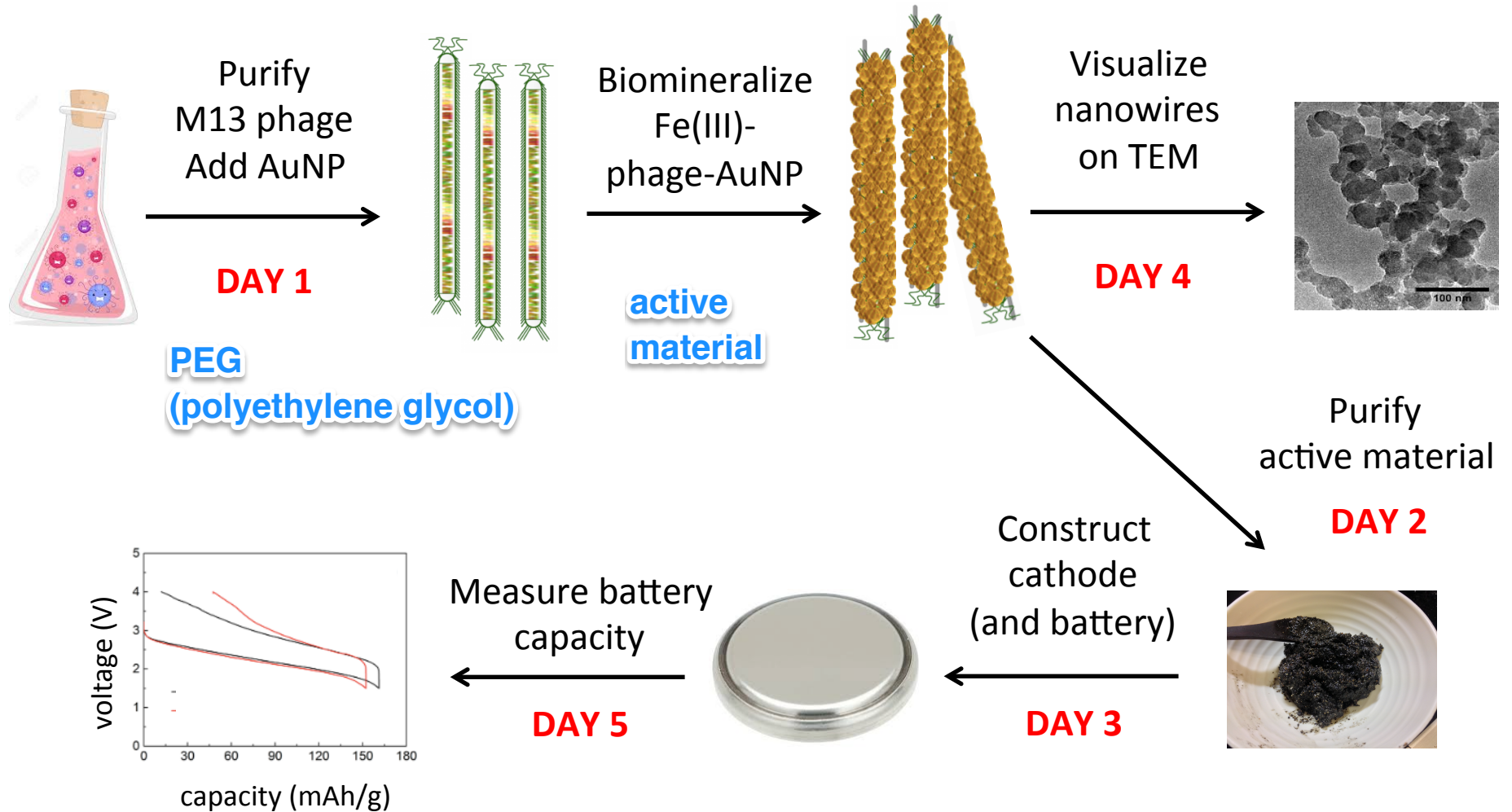
We are in the homestretch!

3	1	R/F Apr 14/15	AB 	Growth of phage materials	Homework due
		T/W Apr 19/20		Patriots' day holiday	System engineering research article due Mon, Apr 18 at 5 pm
3	2	R/F Apr 21/22	AB 	Phage nanowires	Homework due
3	3	T/W Apr 26/27	AB 	Cathode construction	Lab quiz Homework due
		R/F Apr 28/29	AB 	Lecture, but no laboratory	
3	4	T/W May 3/4	AB 	TEM	Homework due
3	5	R/F May 5/6	AB 	Battery assembly and testing	Lab quiz Homework due Biomaterials engineering mini-report due Thu/Fri, May 5/6 at 10 pm
3	6	T/W May 10/11		Research proposal presentations	Research proposal presentation slides due Tue/Wed, May 10/11 at 1pm
		R May 12		Feedback and celebratory lunch	

* (informal) elevator pitches for extensive feedback from Prof. Angela Belcher

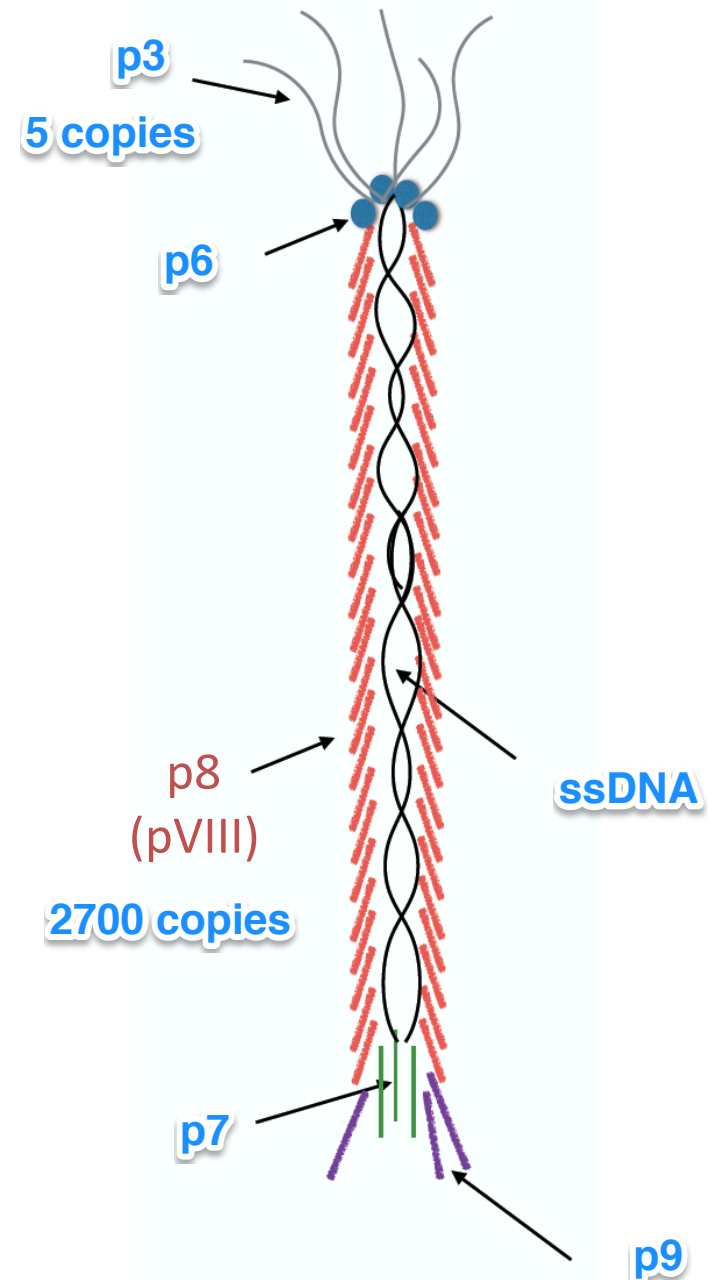
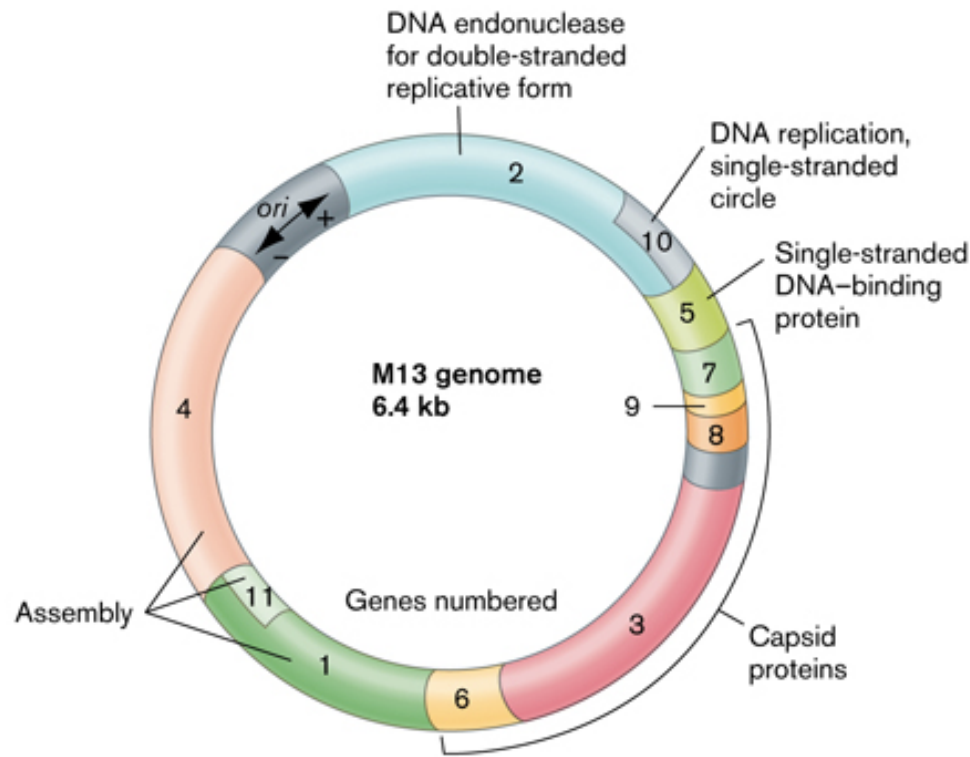
Module 3: biomaterials engineering

How does gold size/quantity affect battery capacity?



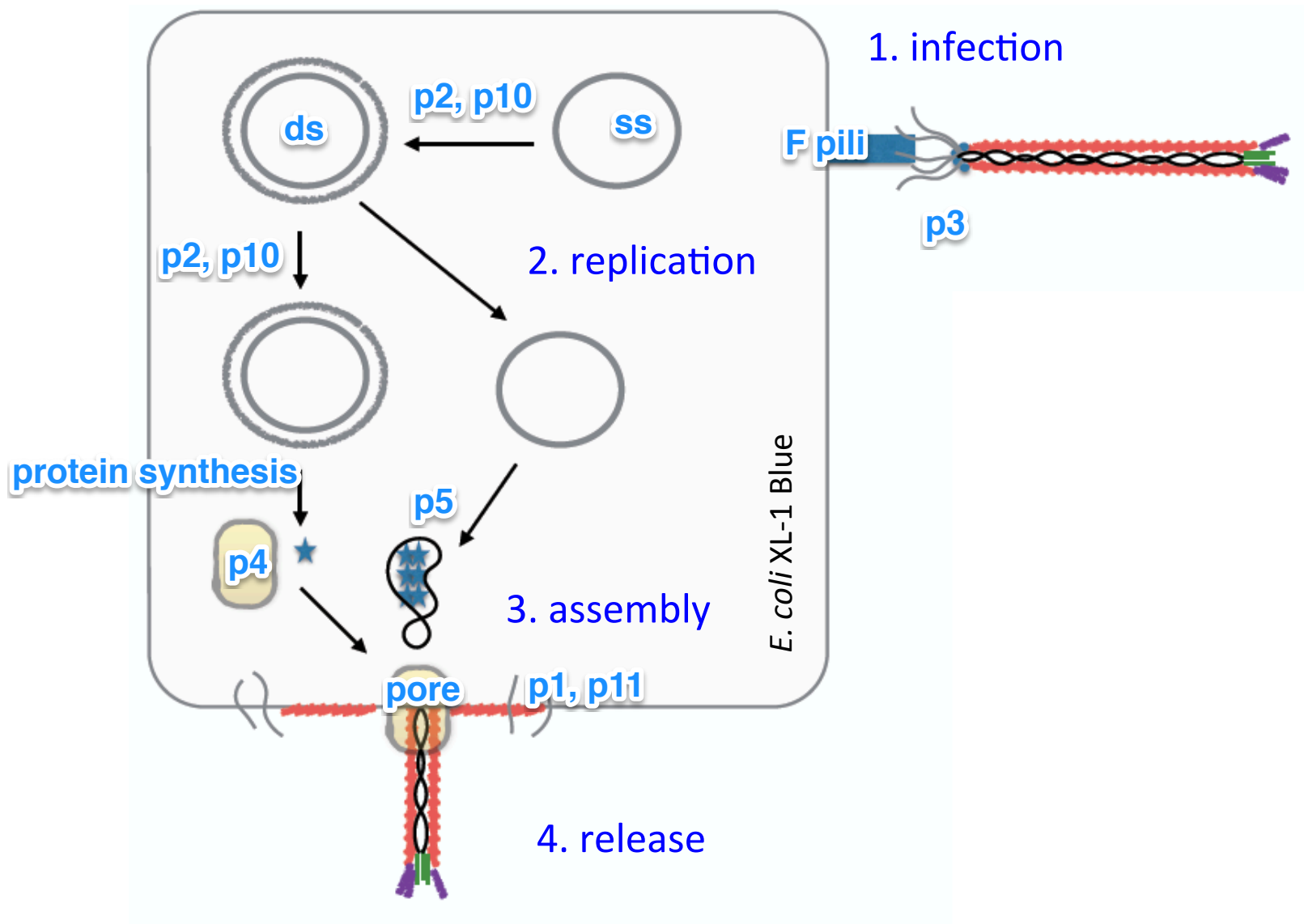
proteins for replication, protein for infection, ssDNA

M13 phage genetics and structure



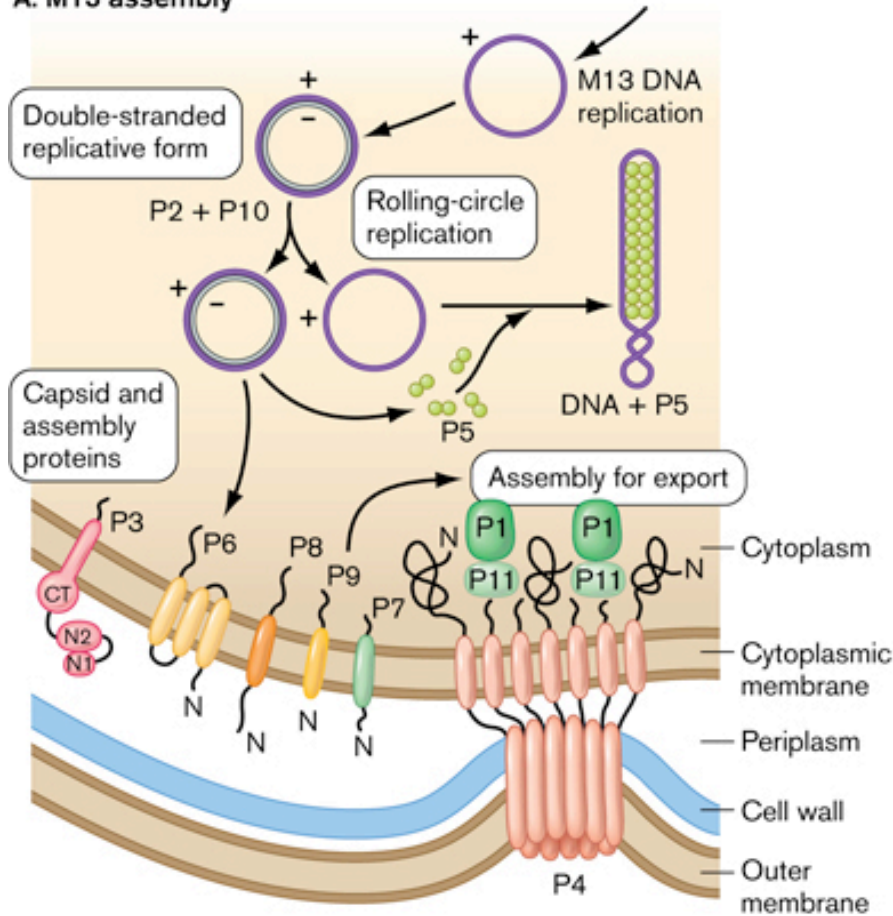
* packaging / coat / capsid

Overview of M13 virus life-cycle

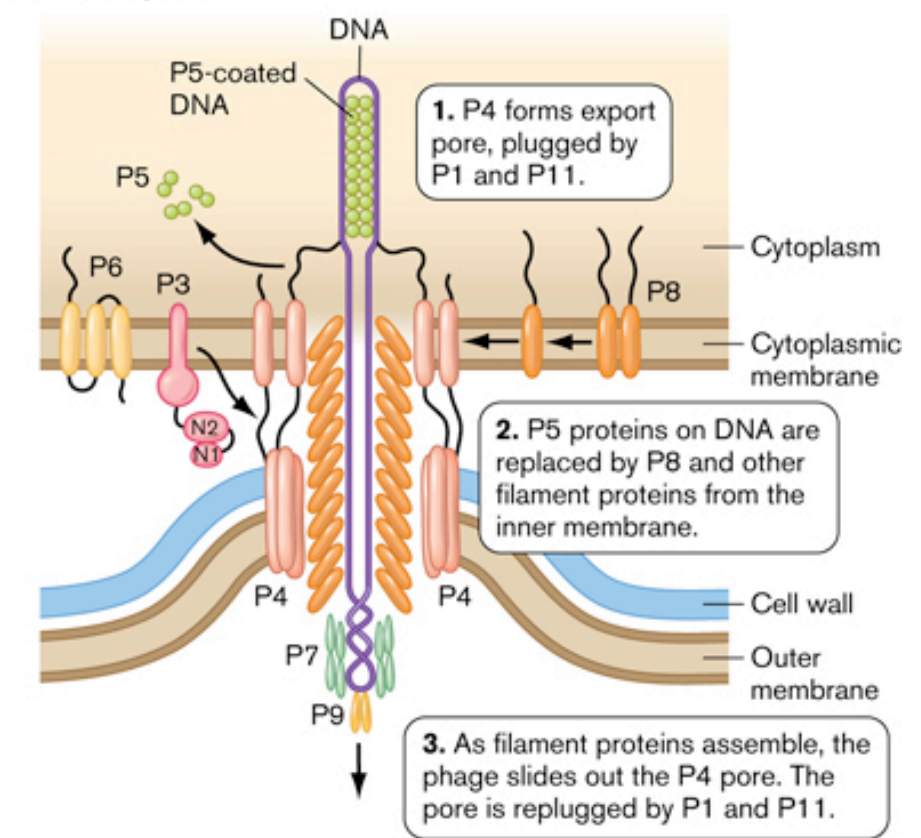


M13 is a nonlytic bacteriophage

A. M13 assembly

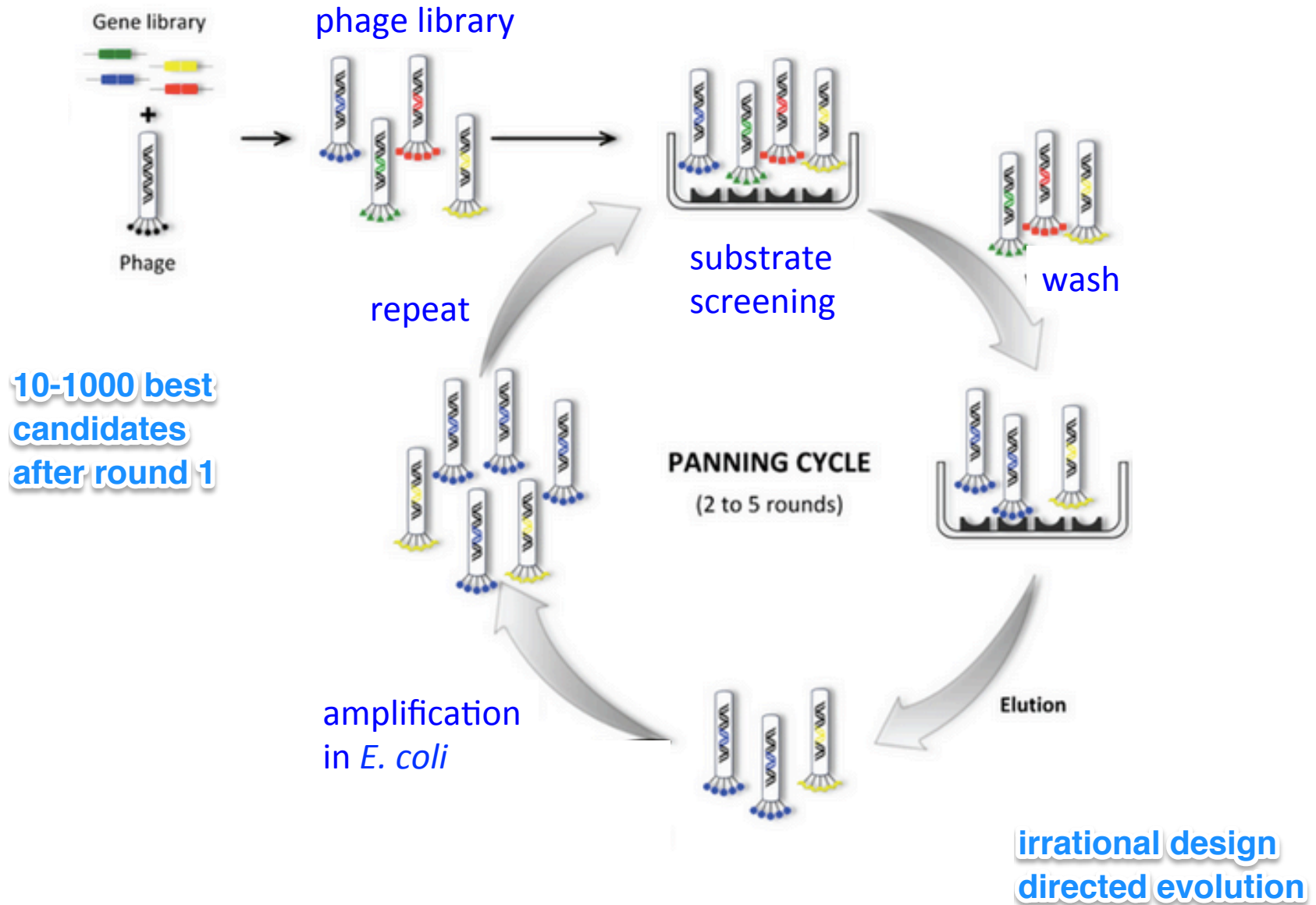


B. M13 export

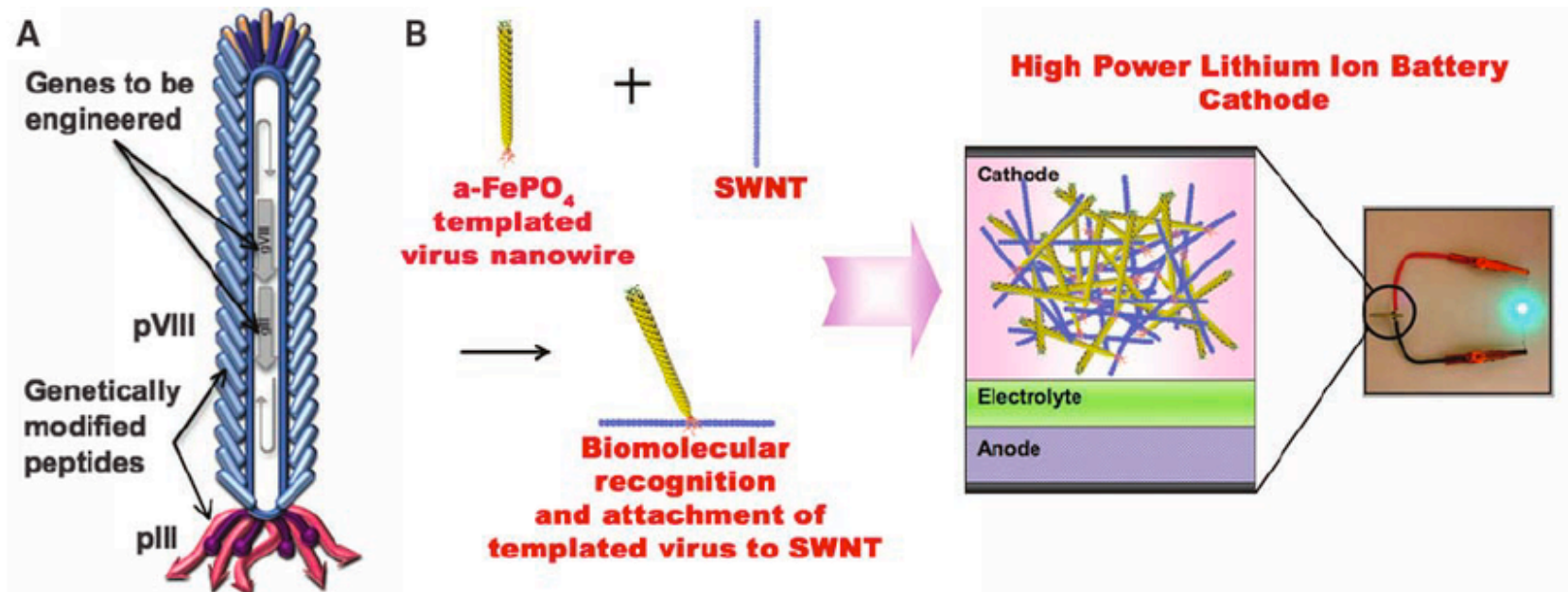


typically start with 10^9 random peptide sequences in library

Overview of phage display



M13 are engineer-able biomaterials

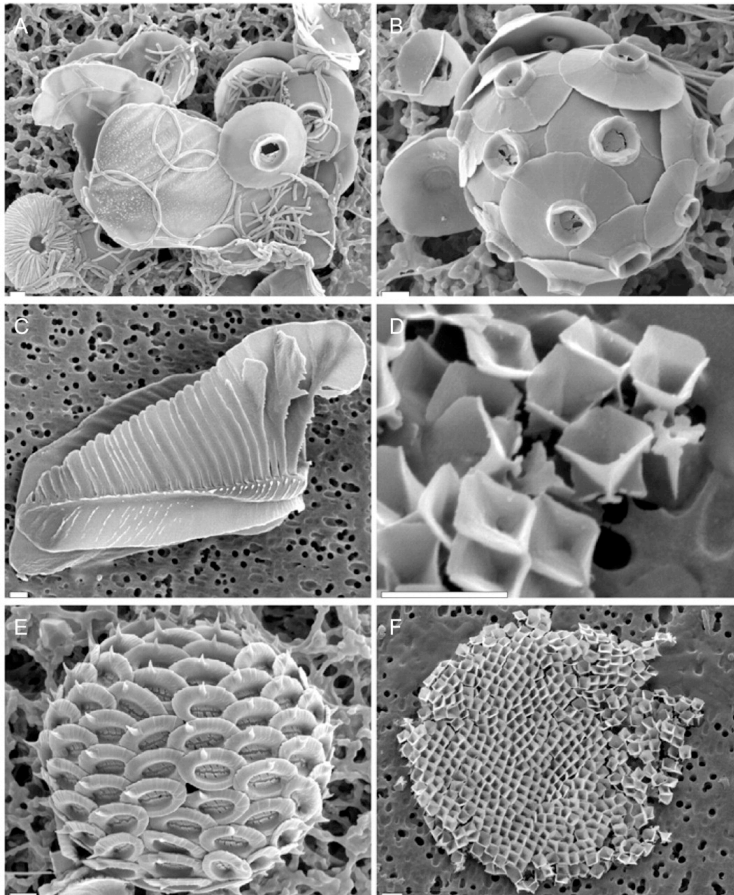


- Our p8 coat protein was mutated to contain sequence DSPHTELP
- Modified p8 proteins bind single wall carbon nanotubes (SWCNT), iron and gold

negatively charged

M13 phage and biomineralization

- Examples from nature:



diatoms

- Engineer M13 for biomineralization:

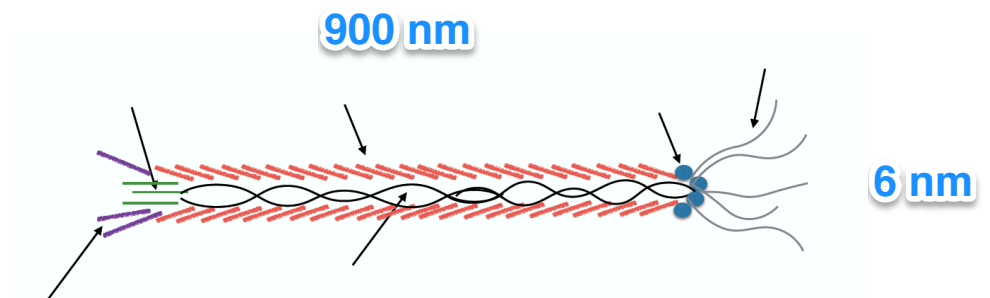
- environmental conditions

4 C, water

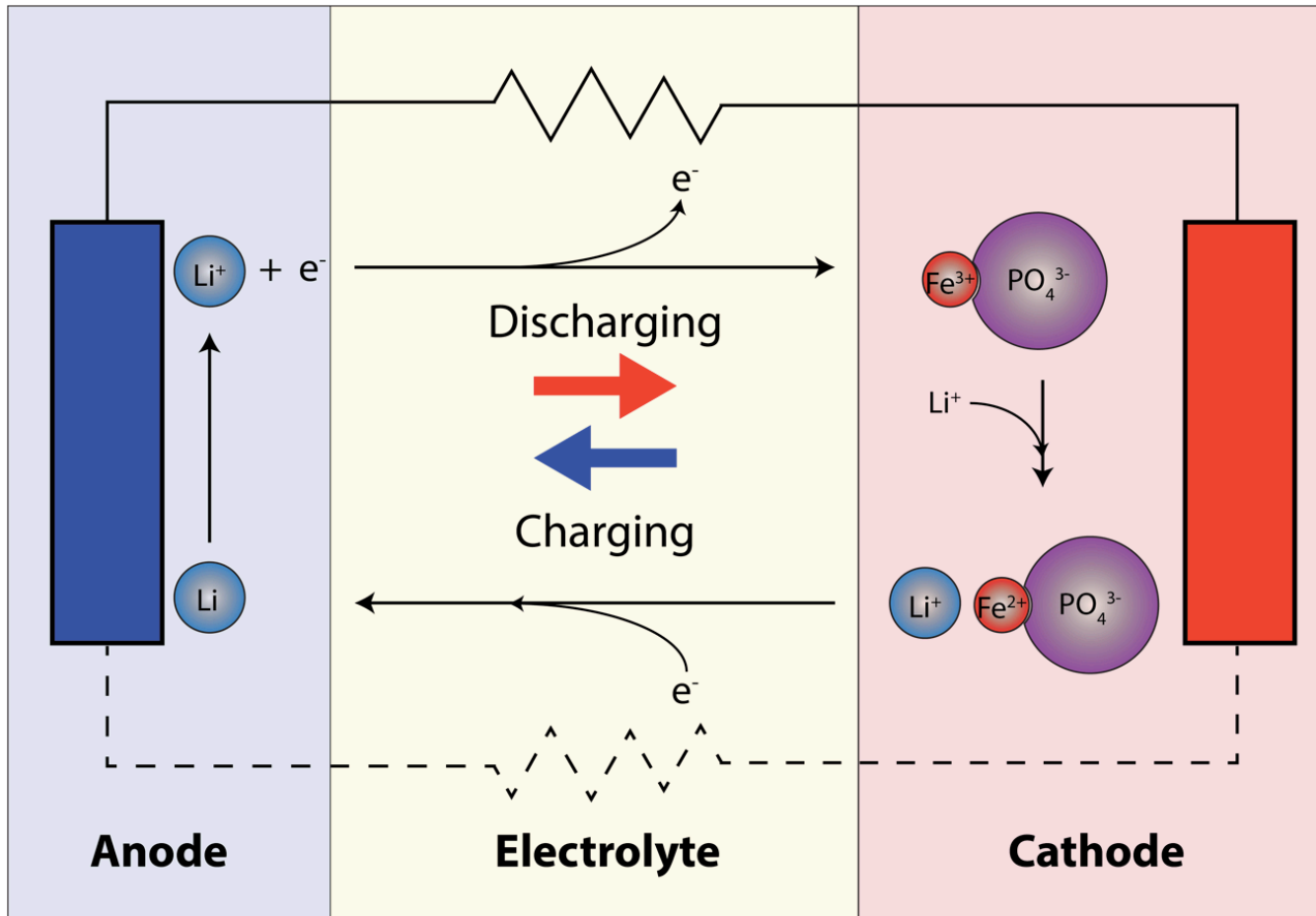
- structural organization

long aspect ratio is a nanowire

- M13 provides scaffold for $\text{Li}(\text{FePO}_4)$ cathode construction



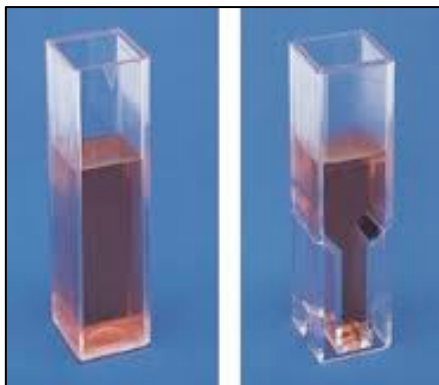
M13 nanowires as battery cathode



Phage titer:



- by plating: plaque assay
 - phage slows *E. coli* growth
 - plaque-forming units: PFU/mL



- by spectrophotometry

$$\# \text{ phage / mL} = \frac{(6 \times 10^{16}) (A_{269} - A_{320})}{\# \text{ bases in phage genome}}$$

7220 bases

❖ quartz cuvettes are expensive!

DNA+proteins

background



Today in lab...

- Purify phage [stop at Part 1, step 6: one hour incubation](#)
- Add gold nanoparticles
- Begin Fe(III)-phage-AuNP biomineralization

