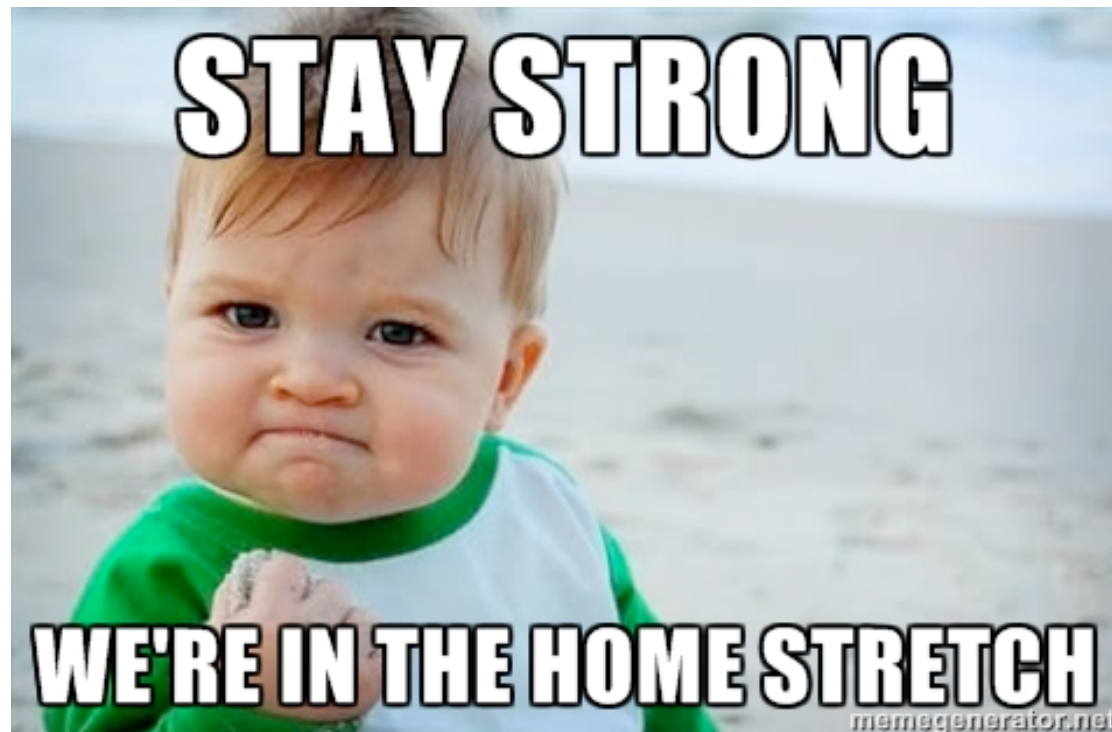


# Today in lab...

- Purify phage
- Add gold nanoparticles
- Begin Fe(III)-phage-AuNP biomineralization

stop at Part 1, step 6:  
1-hour incubation



Nobel Prize winner (chemistry 2015)  
**Paul Modrich** gives the BE seminar!



- Mechanisms of human DNA mismatch repair
  - 4pm on Thursday, 11/17 in NE46 (Ragon Institute)
  - Hosted by Bevin Engelward



# BE CAREER EXPO

November 18, 2016, 3-5pm  
20 Chimneys (W20-306)





Massachusetts Institute of Technology  
Center for Environmental Health Sciences

Sponsored by NIH-NIEHS Core Center P30-ES002109 and the Department of Biological Engineering

## 2017 Center for Environmental Health Sciences Poster Session

Wednesday, Jan. 18, 2017  
2:30pm – 5:00pm  
Lobby of Building 13

Abstract Submission Deadline: [December 2, 2016](#)

The Abstract Form can be found via the CEHS

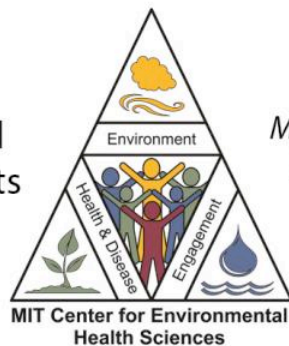
<https://cehs.mit.edu/events/poster-session-2017>

Prizes will be given for the Best Posters  
in Engineering and Life Sciences.

1<sup>st</sup> Place: \$1,000

2<sup>nd</sup> Place: \$500

3<sup>rd</sup> Place: \$200 and  
CEHS gifts



*Supported by the  
Myriam Marcelle Znaty  
Memorial Research*



M3D1:  
Growth of phage materials

Thank you, Jifa Qi & George Sun  
from the Belcher lab!

11/16/2016

As you know...

- Office hours this weekend
  - Saturday: 10am-5pm in 56-302
- Module 2 research article due 5pm on 11/20
- Blog post(s) due 5pm on 11/21

On the horizon:

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



Keep using it!

# We are in the homestretch!

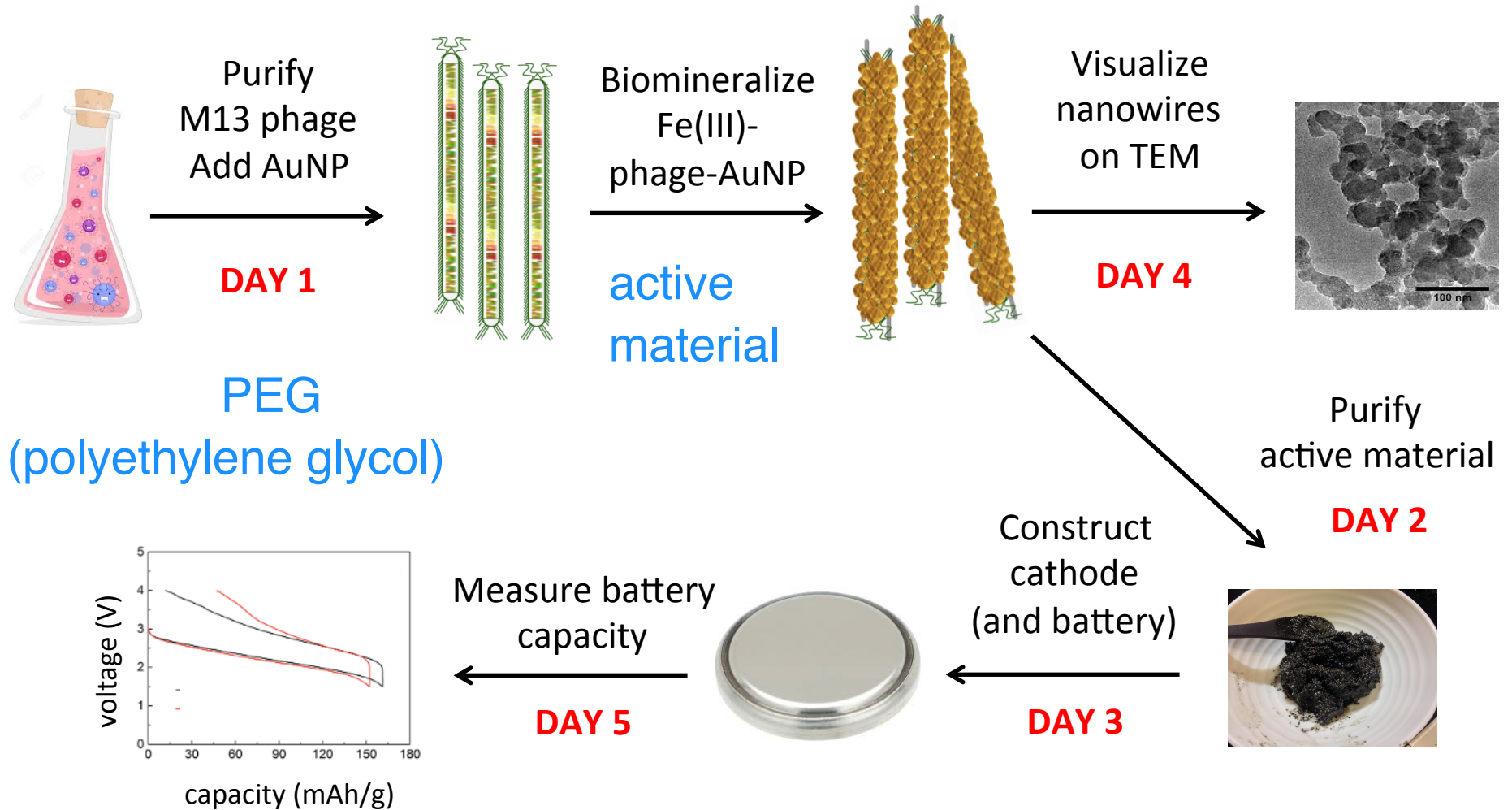
3	1	T/W Nov 15/16	AB 	Growth of phage materials	Homework due
3	2	R/F Nov 17/18	AB 	Purify active materials	Homework due Research article due Sun, Nov 20 at 5 pm Blog post due  Mon, Nov 21 at 5pm
		T/W Nov 22/23	AB 	Lecture, but no laboratory	
		R/F Nov 24/25		Thanksgiving holiday	
3	3	T/W Nov 29/30	AB 	Cathode construction	Lab quiz Homework due
3	4	R/F Dec 1/2	AB 	TEM	Homework due
3	5	T/W Dec 6/7	AB 	Battery assembly and testing	Lab quiz Homework due Blog post due  Wed, Dec 7 at 10pm
3	6	R/F Dec 8/9		Research proposal presentations	Research proposal presentation slides due Thu/Fri, Dec 8/9 at 1 pm
		T Dec 13		Feedback and celebratory lunch	Biomaterials engineering mini-report due Mon, Dec 12 at 10 pm Blog post due  Wed, Dec 14 at 10pm

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

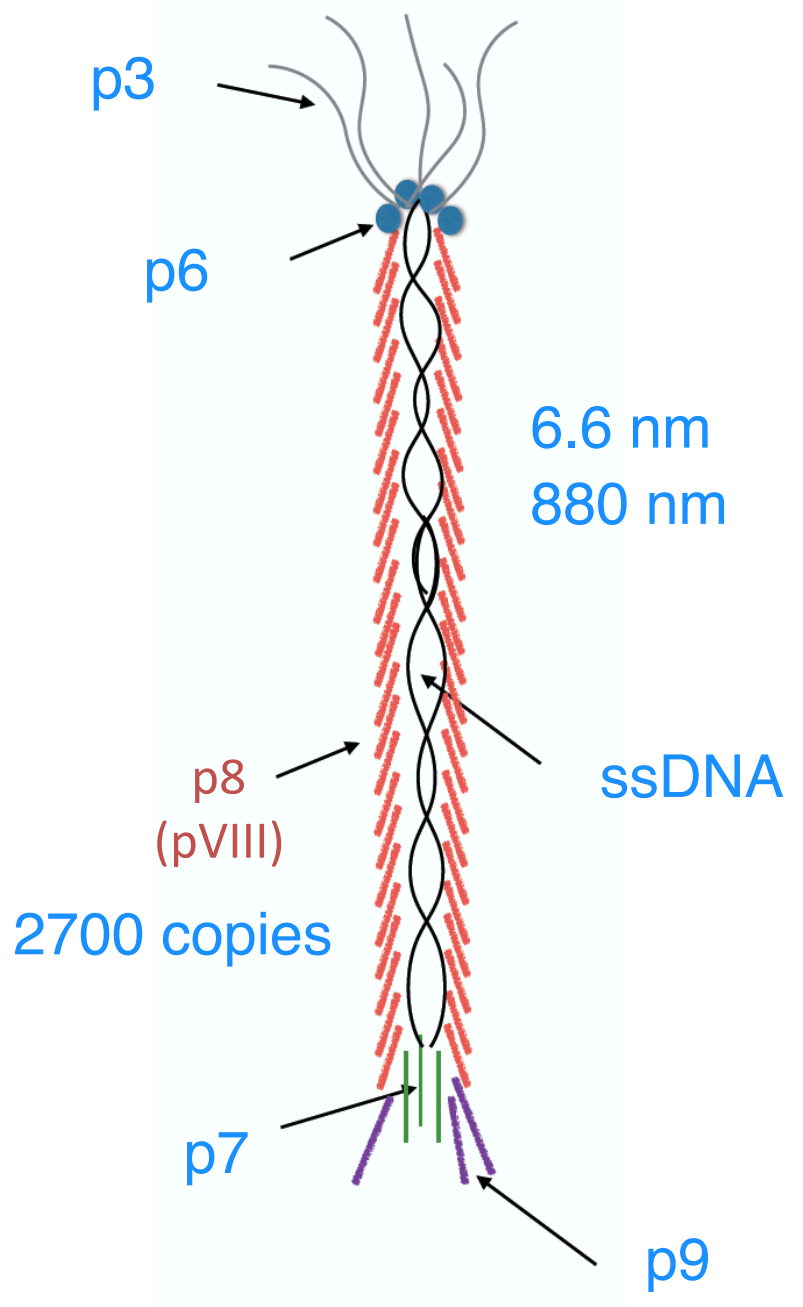
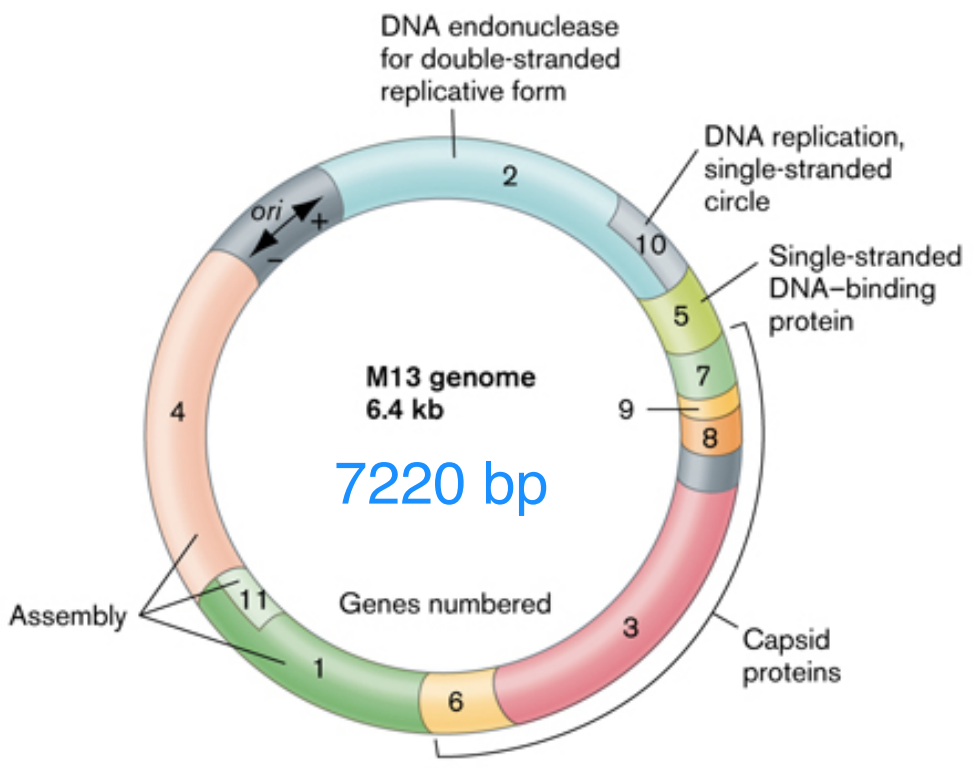


# Module 3: biomaterials engineering

## How does gold size/quantity affect battery capacity?

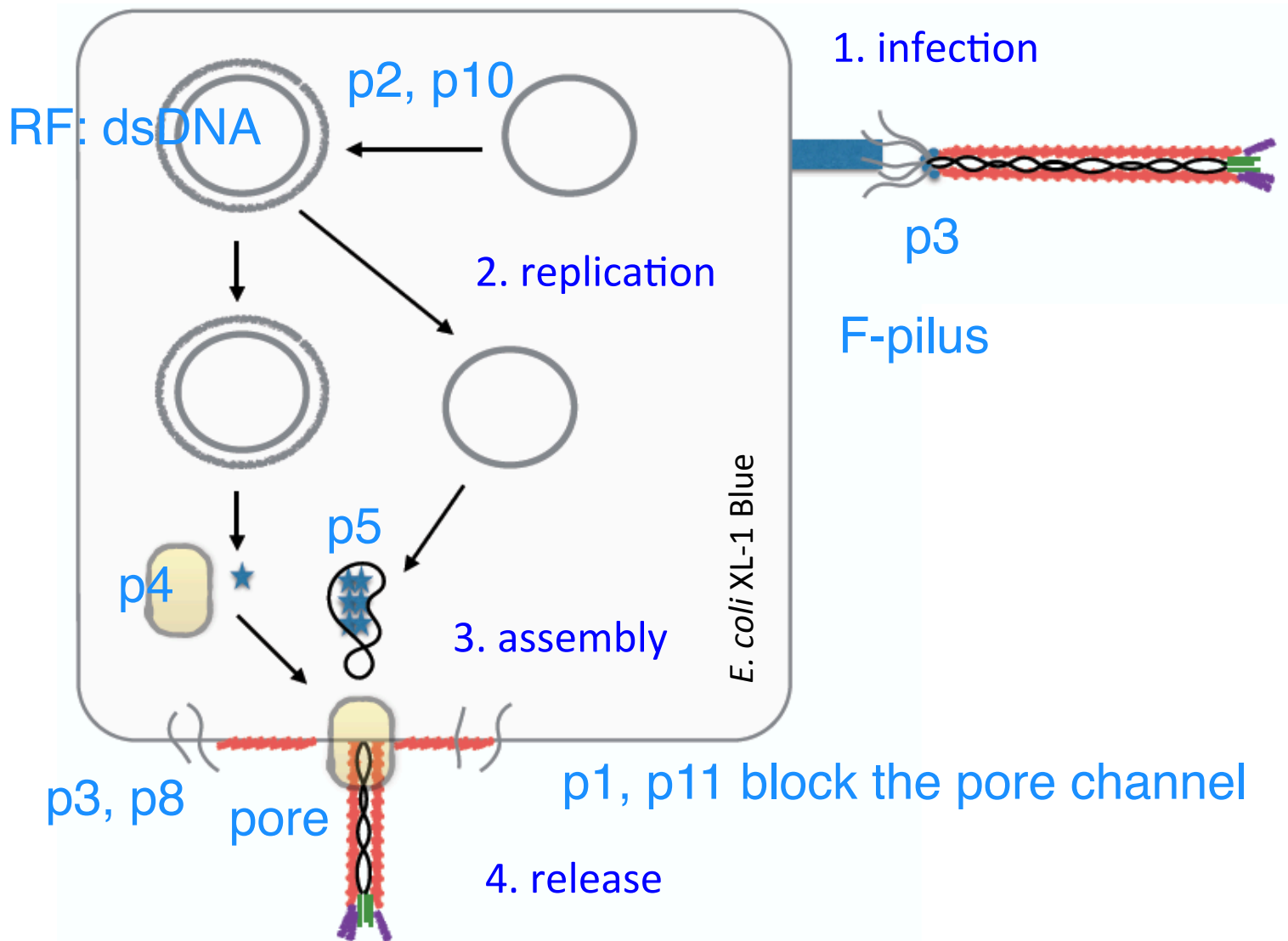


# M13 phage genetics and structure



\* packaging / coat / capsid

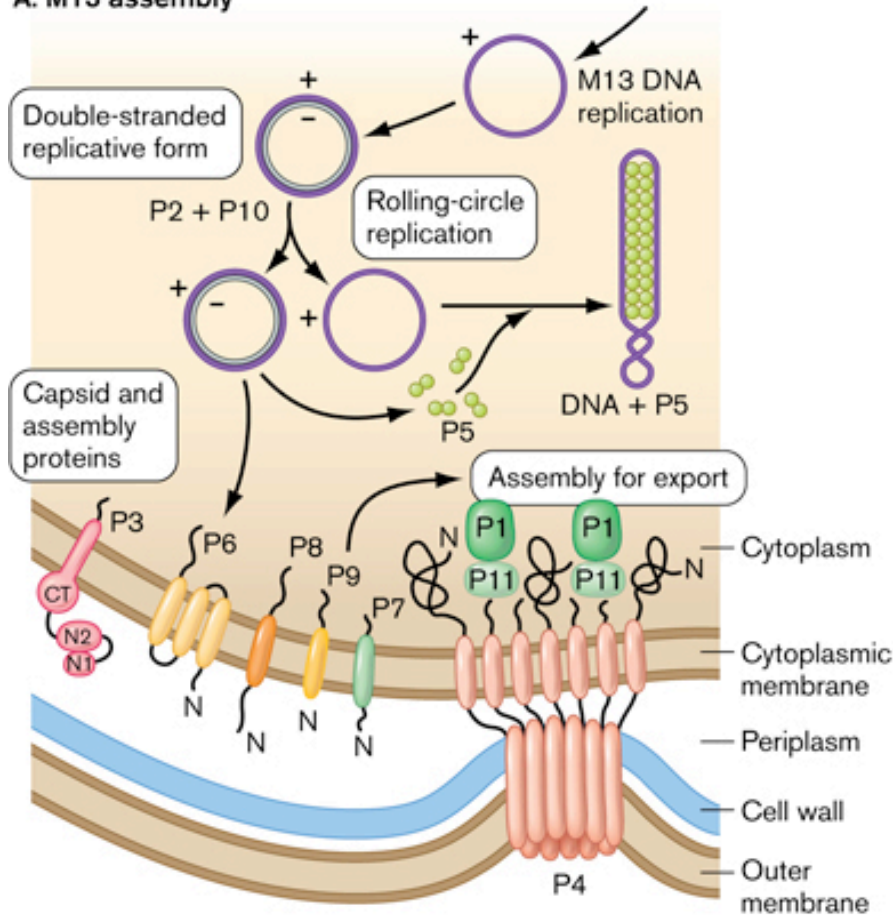
# Overview of M13 virus life-cycle



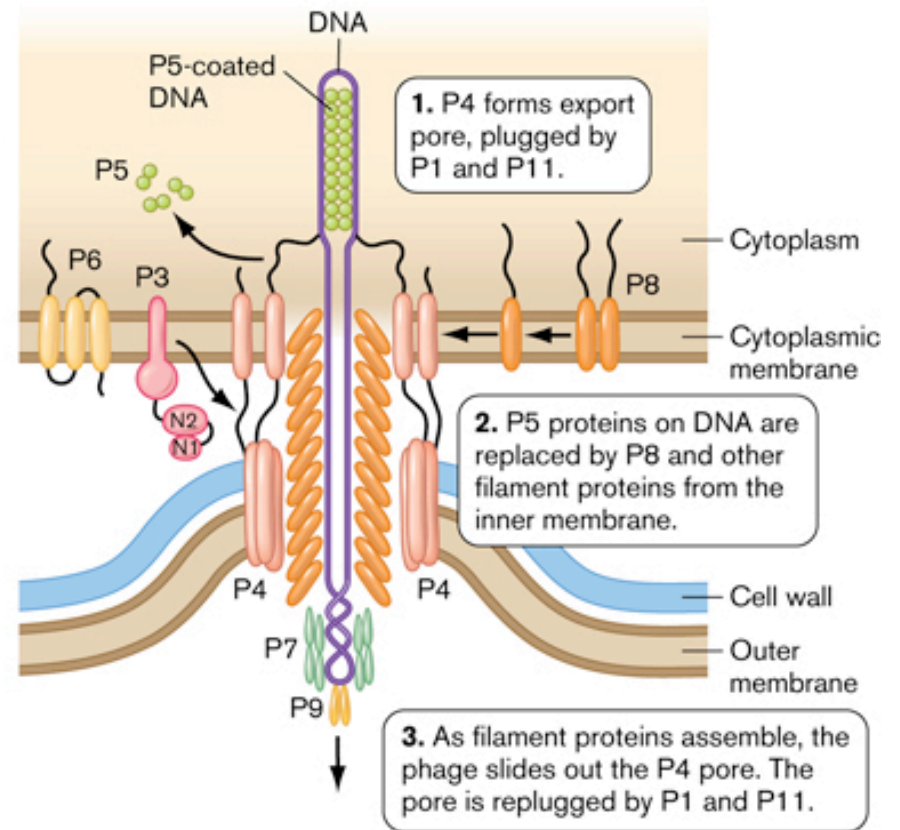


# M13 is a nonlytic bacteriophage

A. M13 assembly

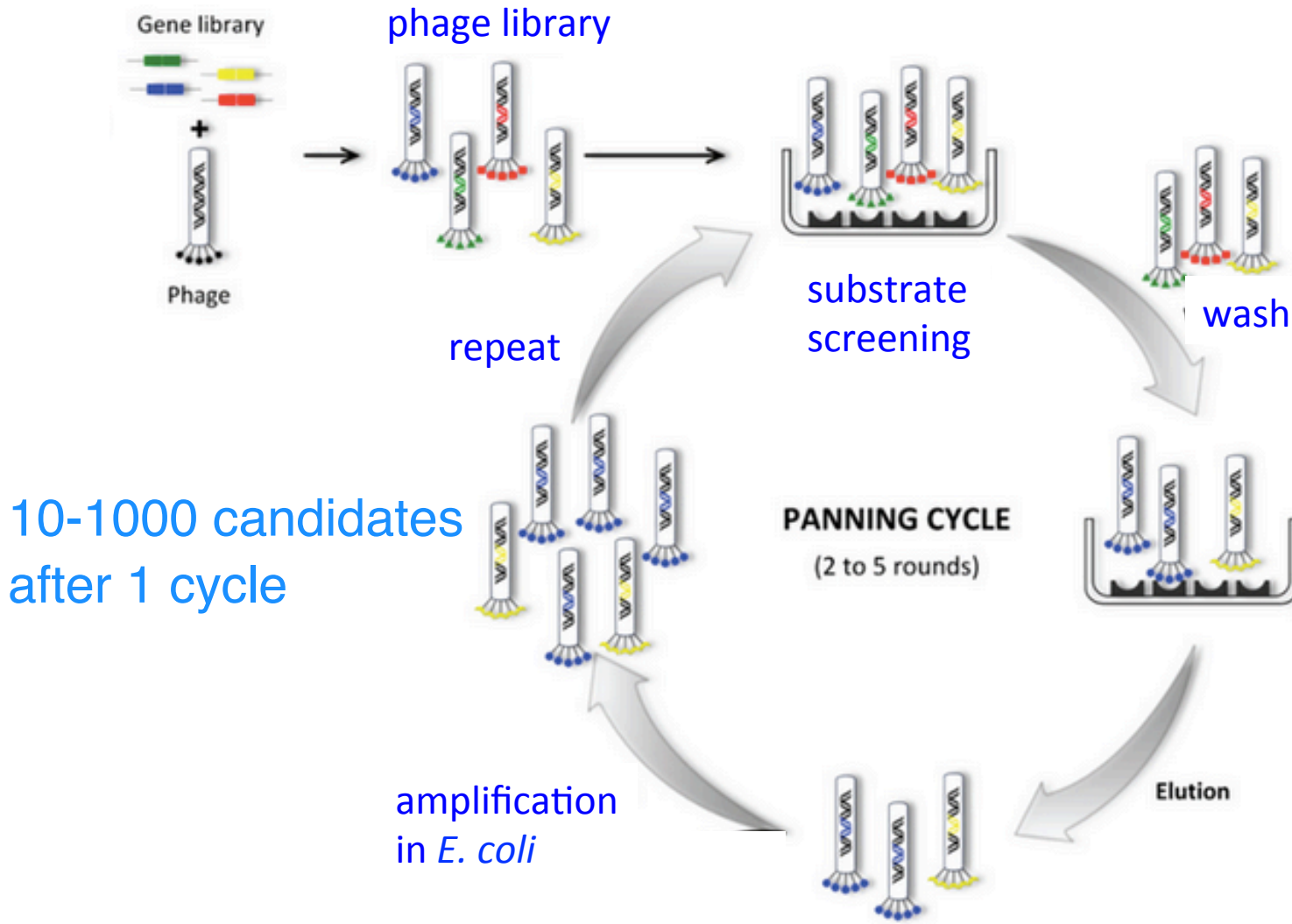


B. M13 export



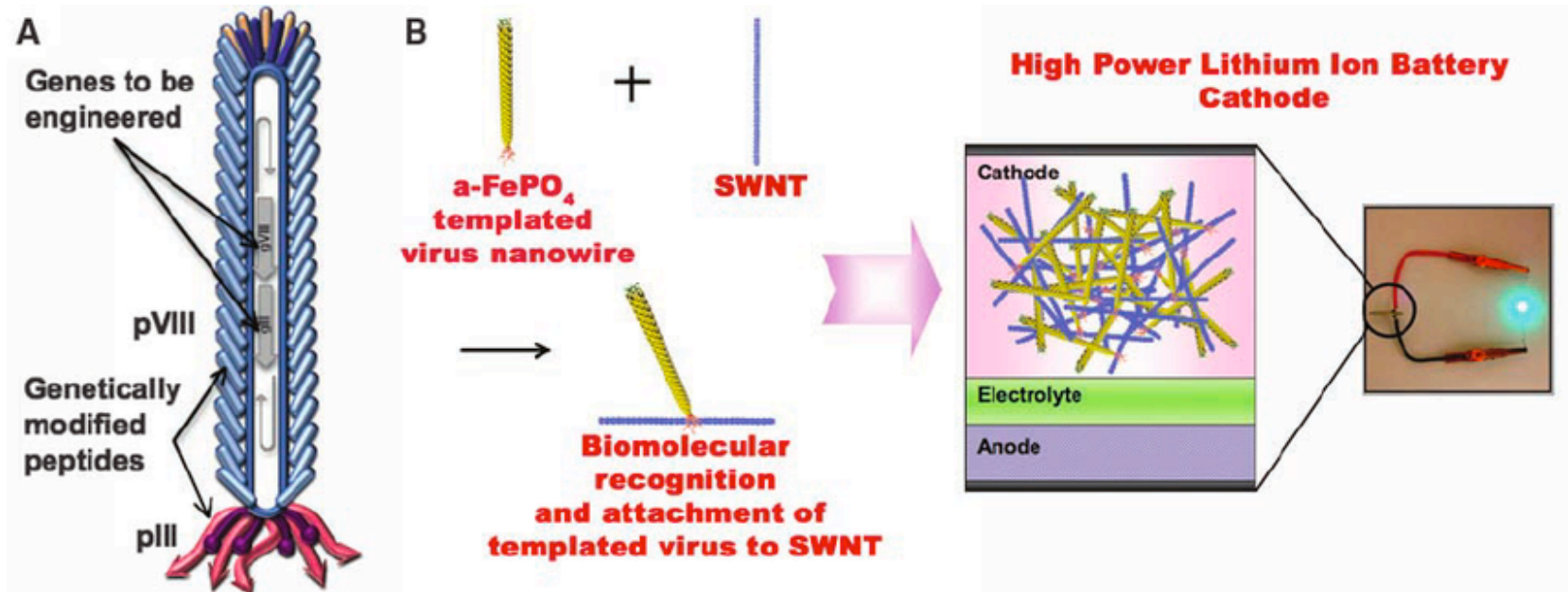
typically, start with  $10^9$  variants of g8

# Overview of phage display



# M13 are engineer-able biomaterials

greencarcongress.org ©

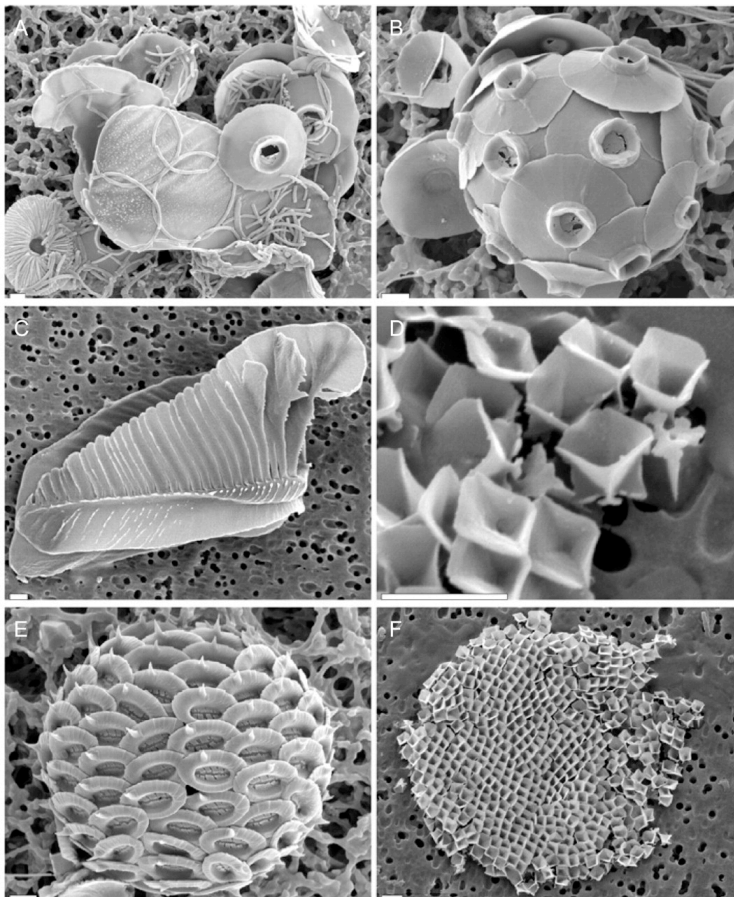


- Our p8 coat protein was mutated to contain sequence **DSPHTELP** negatively charged
- Modified p8 proteins bind single wall carbon nanotubes (SWCNT), iron and gold charged



# M13 phage and biomineralization

- Examples from nature:



diatoms

- Engineer M13 for biomineralization:

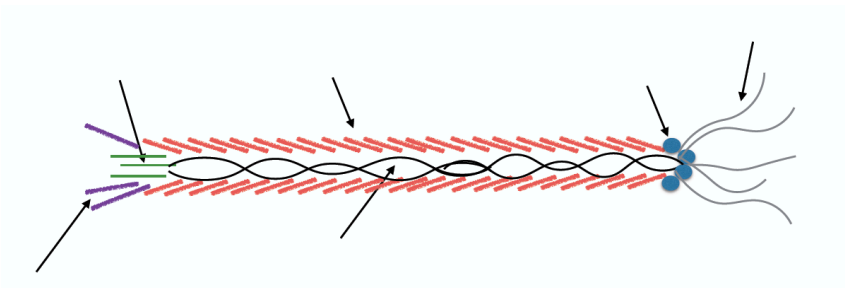
- environmental conditions

4C, aqueous, lower toxicity

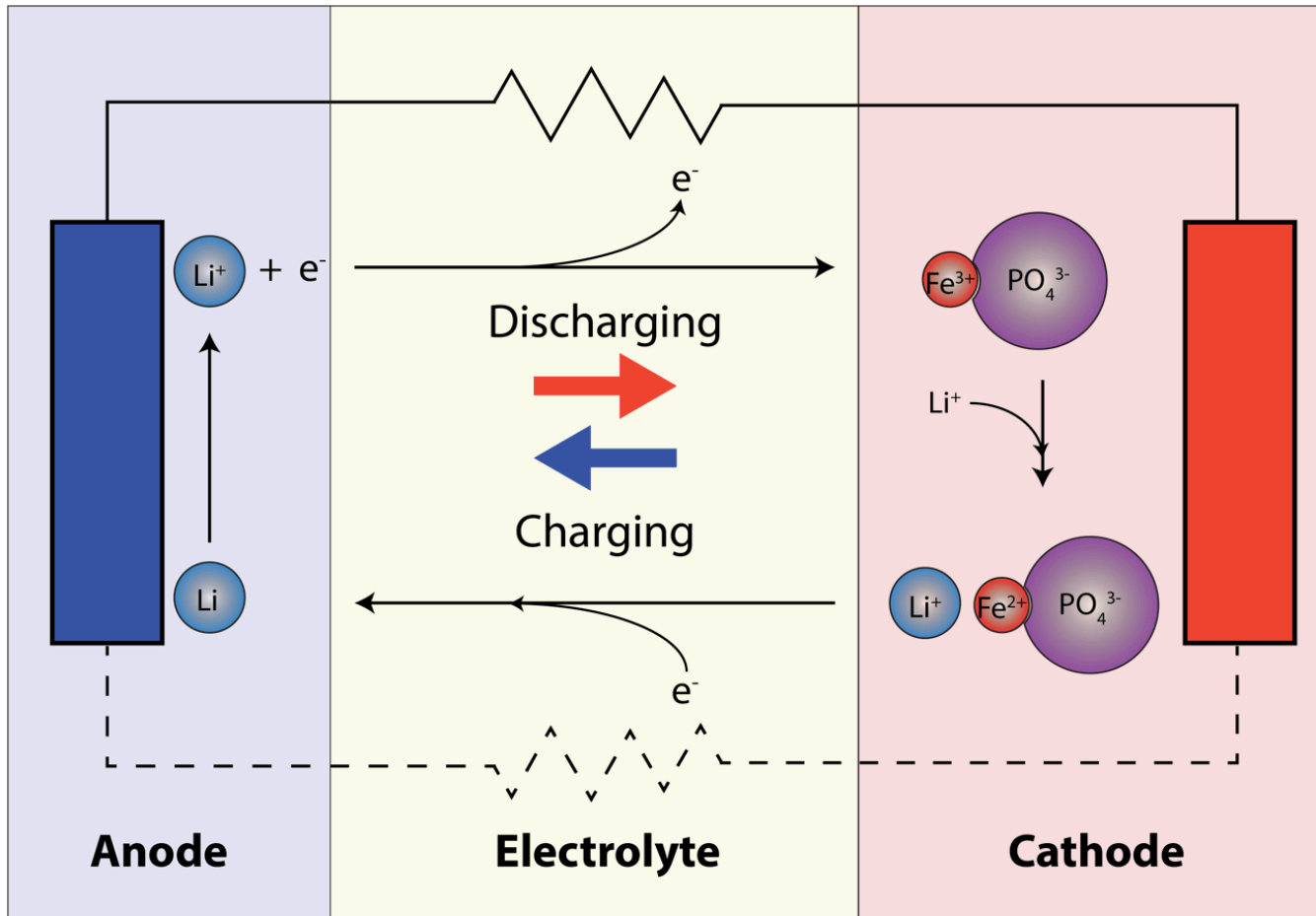
- structural organization

wiry aspect ratio

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



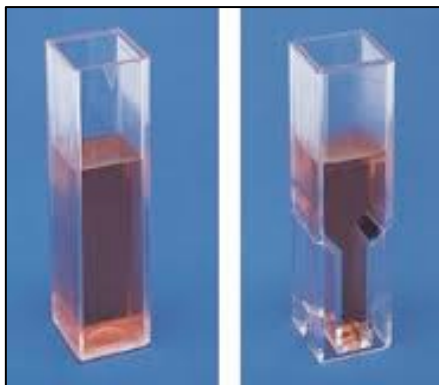
# M13 nanowires as battery cathode



# Phage titer:



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



- by spectrophotometry

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

DNA + proteins

background

7220 bases

The equation is annotated with blue arrows: one points from 'DNA + proteins' to the term  $(A_{269} - A_{320})$ , and another points from 'background' to the same term. A third blue arrow points from '# bases in phage genome' to the value '7220 bases' below the denominator.

❖ quartz cuvettes are expensive!

Research question: .... (4nm or 9nm) .....

## Today in lab...

- Purify phage
- Add gold nanoparticles 40 AuNP / phage
- Begin Fe(III)-phage-AuNP biomineralization

