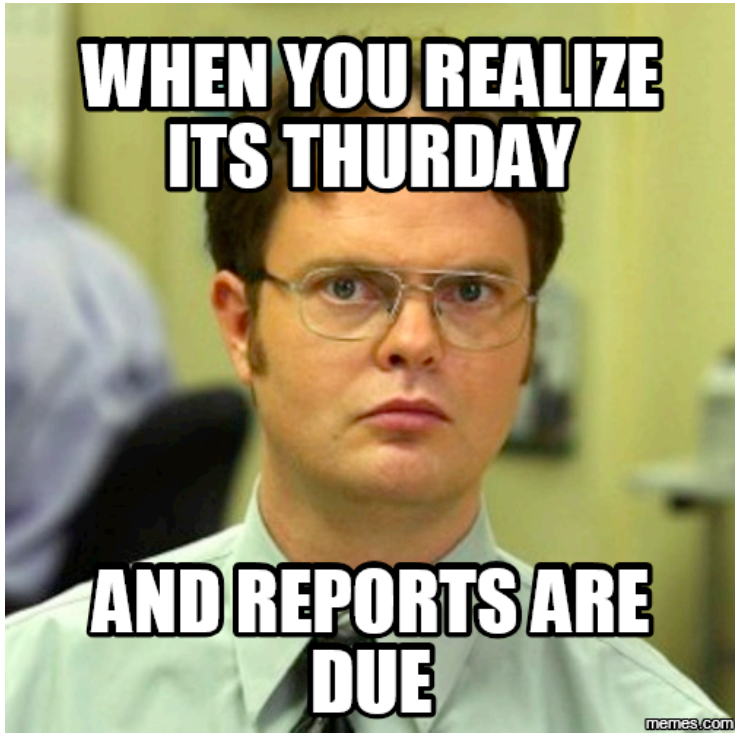
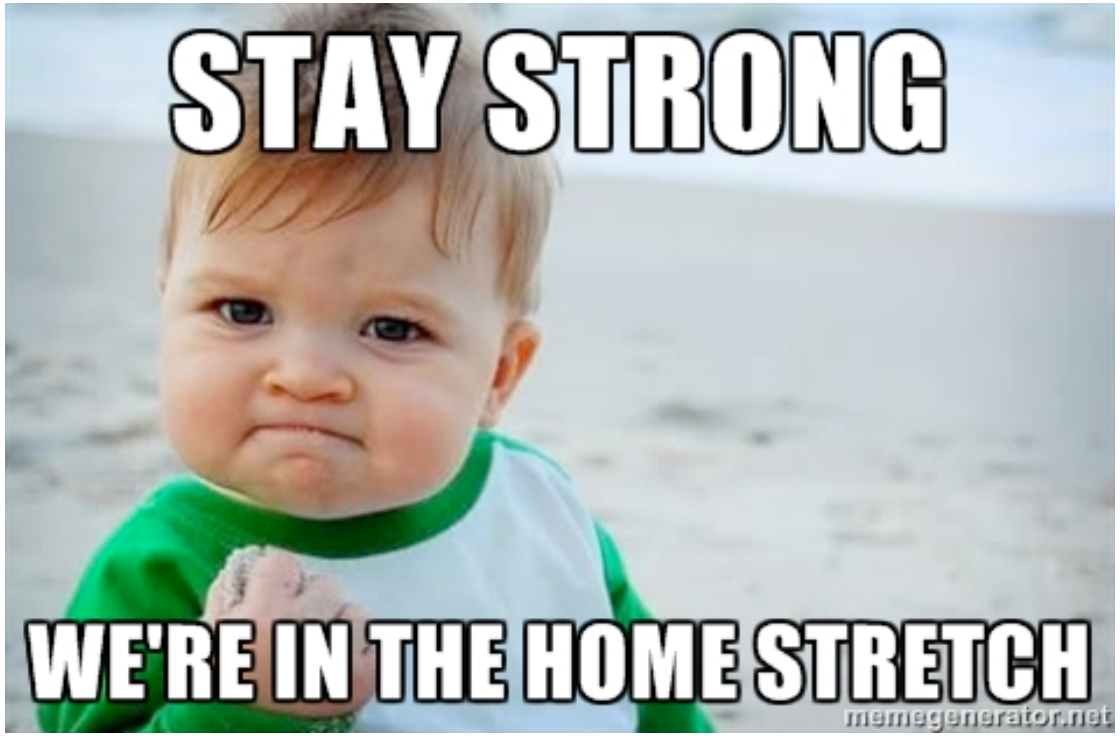
Today in lab:

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

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





M3D1:
Growth of phage materials

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

04/20/2017

As you know…

- Module 2 research article due 10pm on 04/22
- Blog post due 10pm on 04/23

On the horizon, M3 major assignments:

- Research proposal oral presentation (20%) on 05/11
  - Homework
  - Discussions with Prof. Angie Belcher
- Blog post due 10pm on 05/11
- Mini-report (5%) due 10pm on 05/16

MIT BE
BIOLOGICAL ENGINEERING
Communication Lab

Keep using it!

We are in the homestretch!

		T/W Apr 18/19		Patriots' day holiday	
3	1	R/F Apr 20/21	AB	Grow phage active material	Homework due Research article due April 22 at 10 pm Blog post due Sun, Apr 23 at 10 pm
3	2	T/W Apr 25/26	AB	Purify phage active material	Laboratory quiz Homework due
3	3	R/F Apr 27/28		Construct cathode with phage active material	Homework due
3		T/W May 2/3	AB	Lecture, but no laboratory	
3	4	R/F May 4/5	AB	Visualize phage nanowires using TEM	Homework due
3	5	T/W May 9/10	AB	Assemble and test battery	Laboratory quiz Homework due
		R/F May 11/12	no lecture	Research proposal presentations	Blog post due Thu/Fri, May 11/12 at 10 pm
		T/W May 16/17		Open office hours	Mini report due Tue/Wed, May 16/17 at 10 pm
		R May 18		Feedback and celebratory lunch	

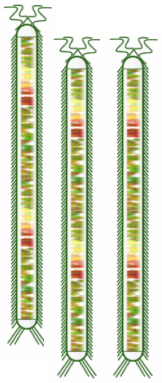
* (informal) elevator pitches for extensive feedback from Prof. Angie Belcher

Module 3: biomaterials engineering

How does gold quantity affect battery capacity?

Purify
M13 phage
Add AuNP

DAY 1

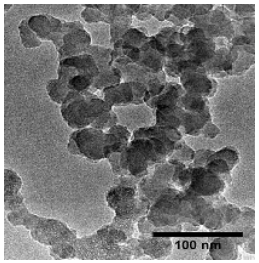


Biomineralize
Fe(III)-
phage-AuNP

active
material

Visualize
nanowires
on TEM

DAY 4



PEG: polyethylene glycan

Purify
active material

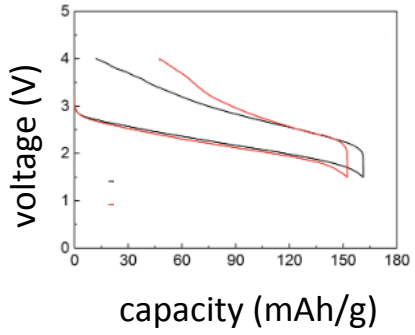
DAY 2

Construct
cathode
(and battery)

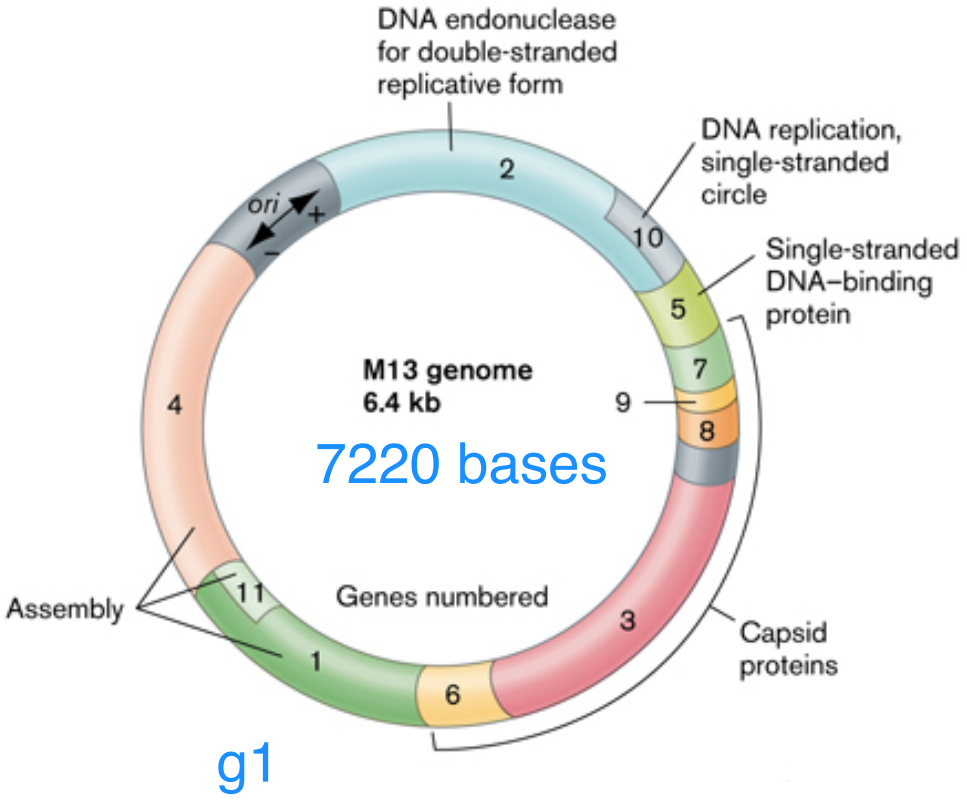
DAY 3

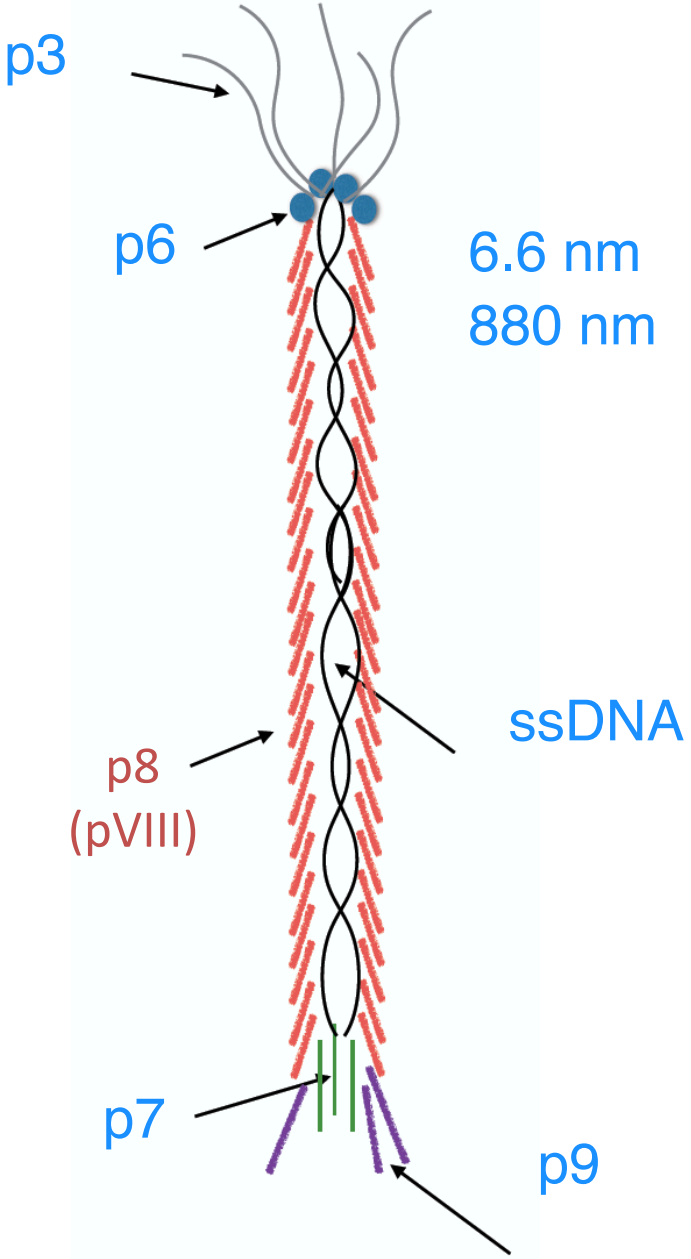
Measure battery
capacity

DAY 5



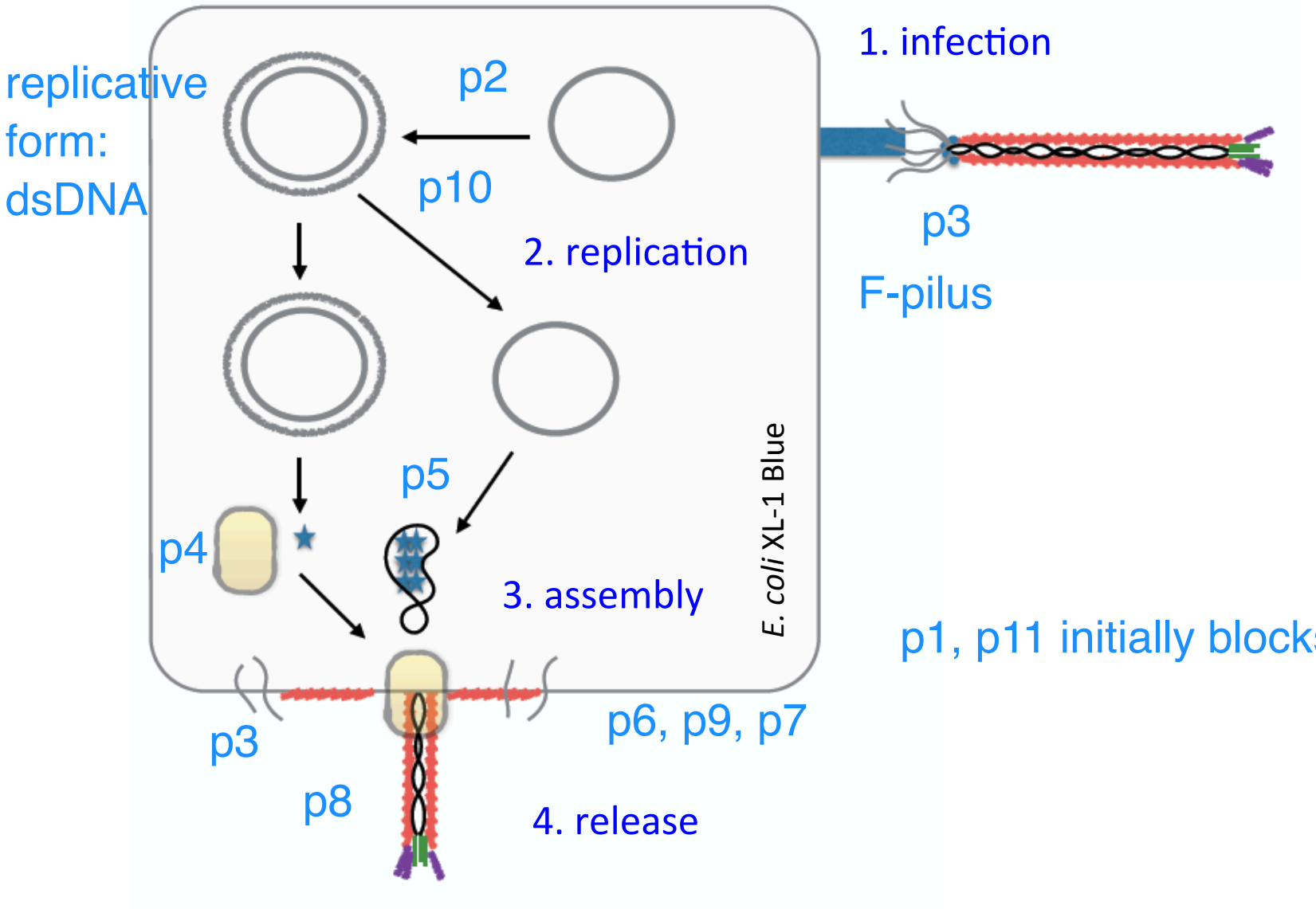
M13 phage genetics and structure





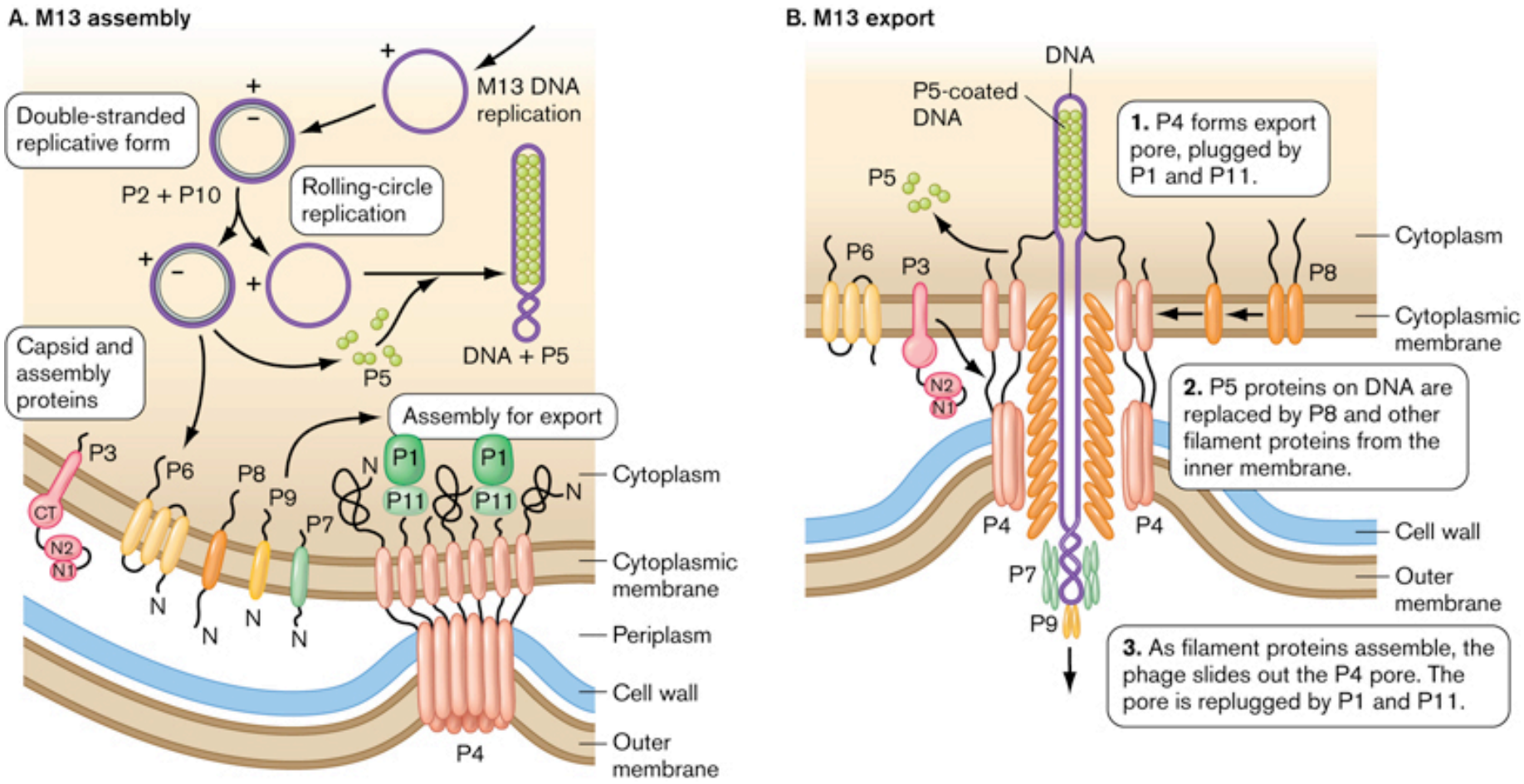
* packaging / coat / capsid

Overview of M13 virus life-cycle



not lethal

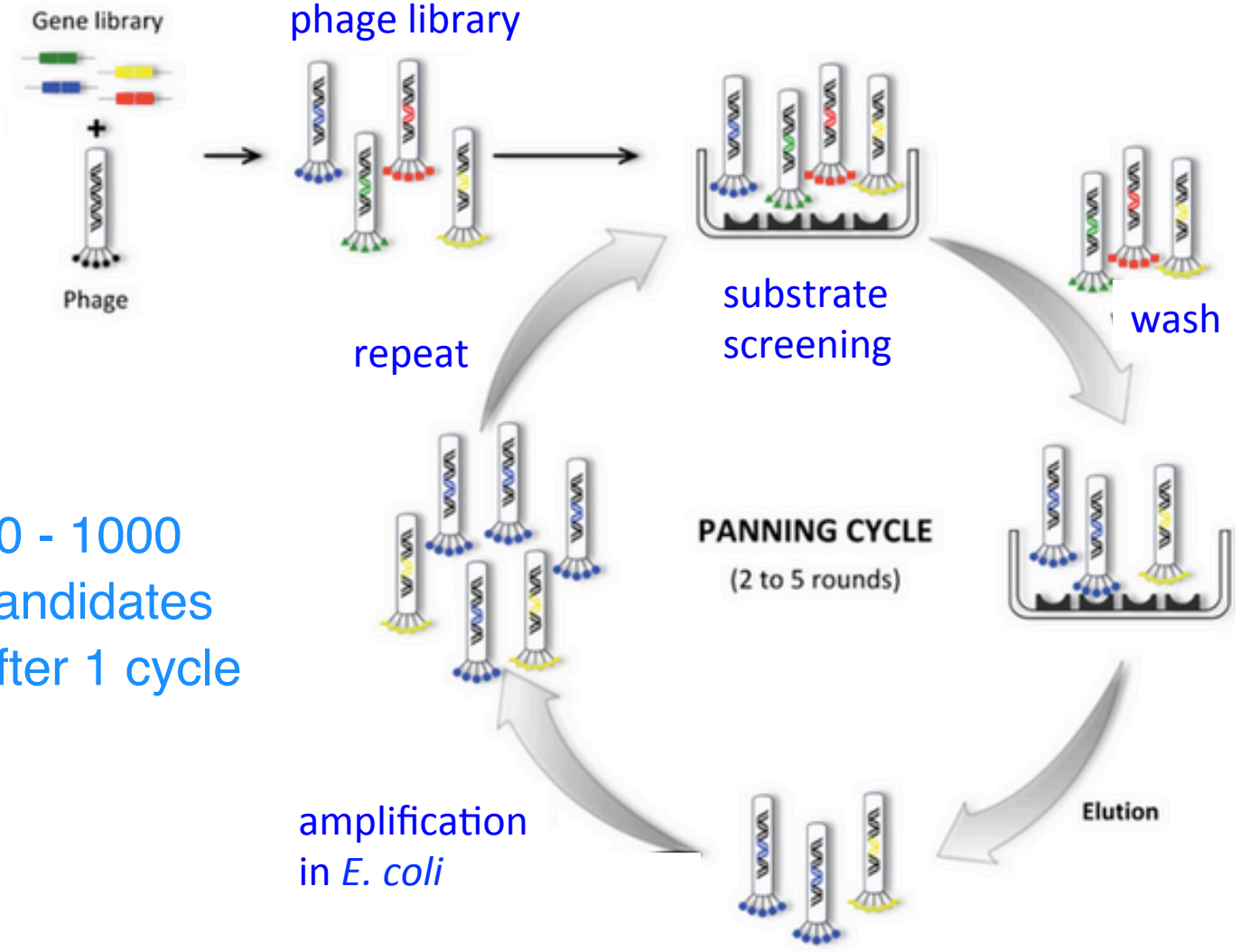
M13 is a nonlytic bacteriophage



http://www.wwnorton.com/college/biology/microbiology2/ch/11/etopics.aspx

typically, start with 10^9 variants of g8

Overview of phage display



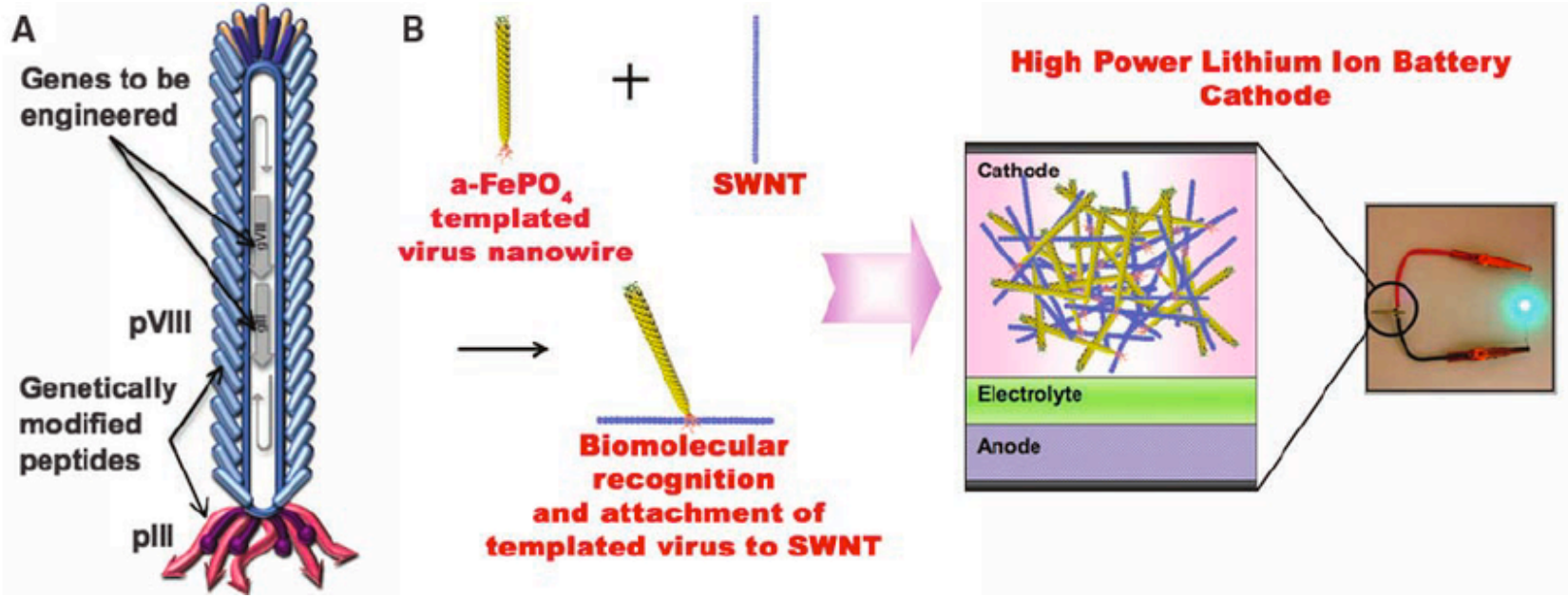
10 - 1000 candidates after 1 cycle

Biomolecules 2015, 5(3), 1783-1809; doi:10.3390/biom5031783

M13 are engineer-able biomaterials

negatively charged

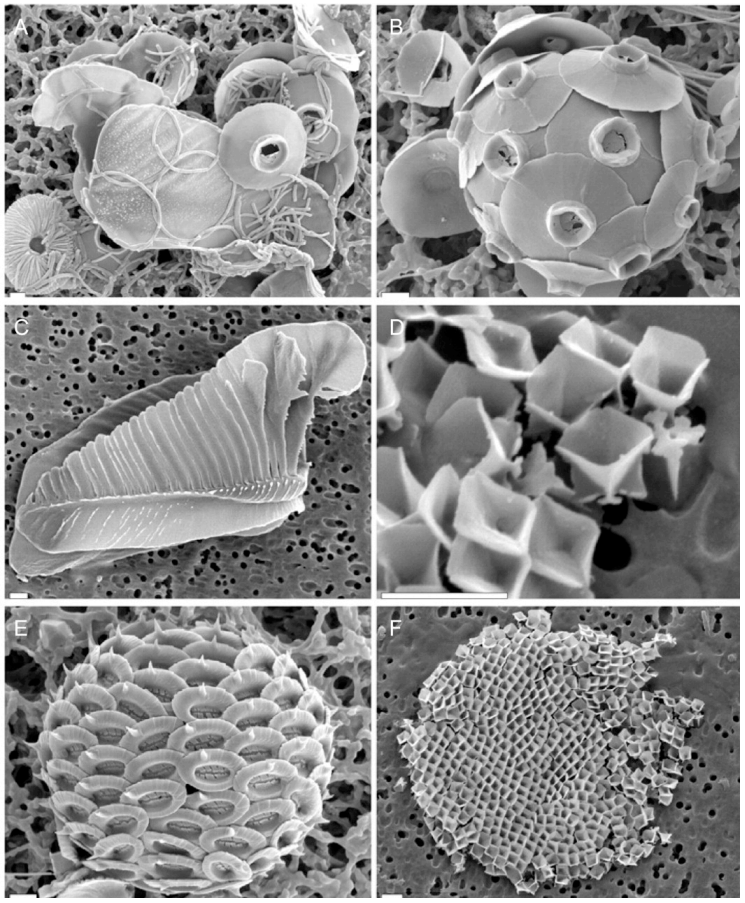
- Our p8 coat protein was mutated to contain sequence DSPHTELP
- Modified p8 proteins bind single wall carbon nanotubes (SWCNT), iron and gold



greencarcongress.org ☺

M13 phage and biomineralization

- Examples from nature:

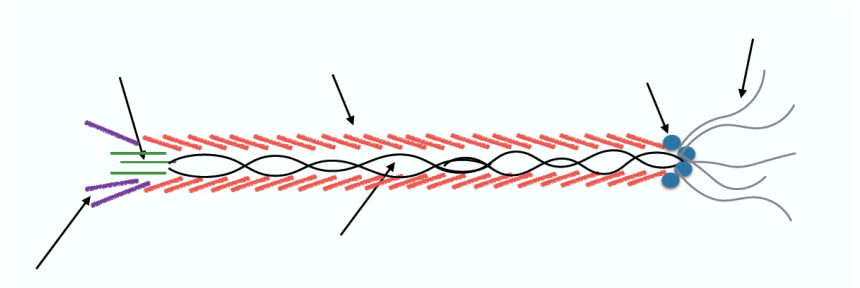


diatoms

- Engineer M13 for biomineralization:
  - environmental conditions
    4C, atmospheric pressure, low toxicity, aqueous
  - structural organization

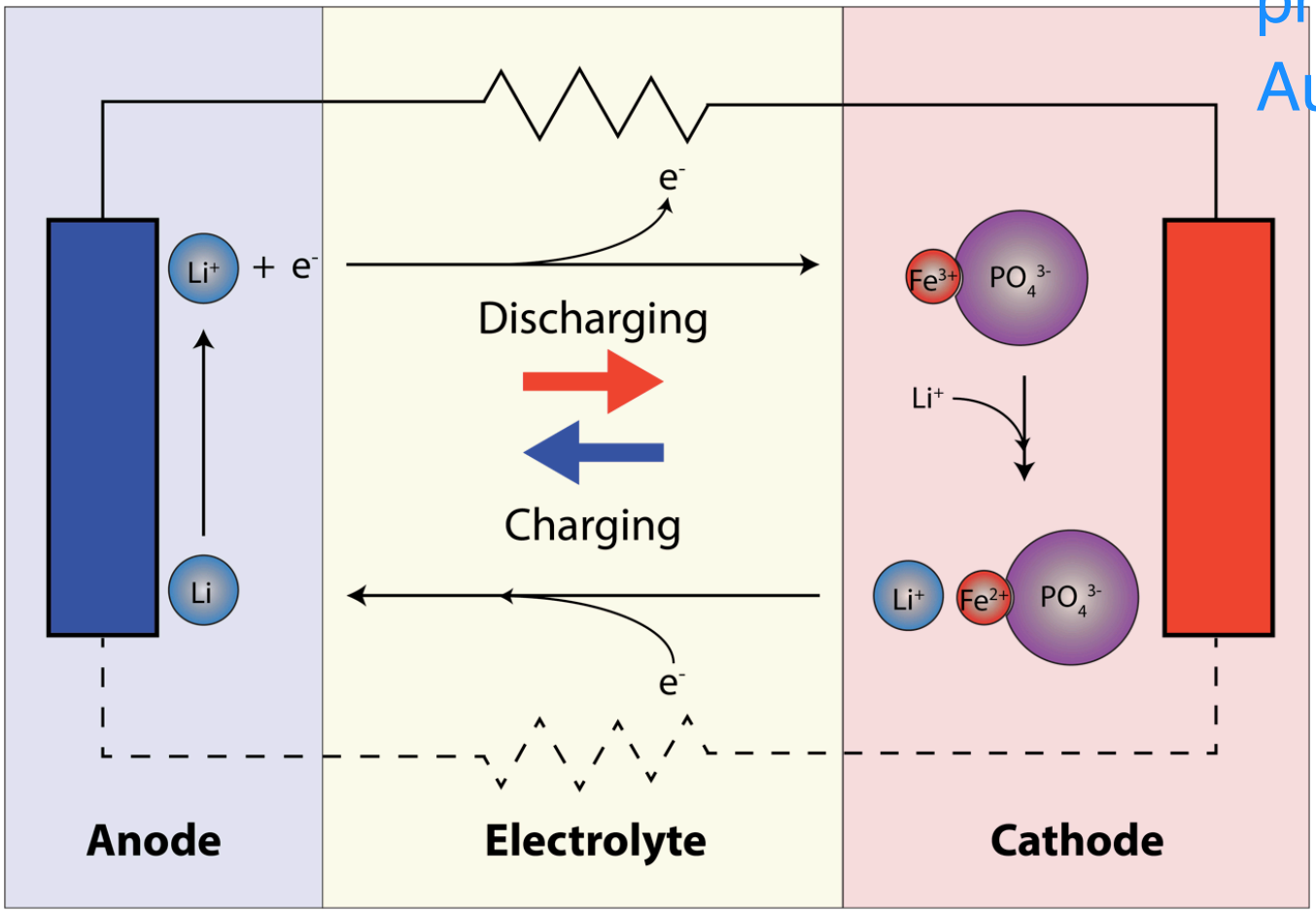
    wiry aspect ratio

- M13 provides scaffold for Li($FePO_4$) cathode construction



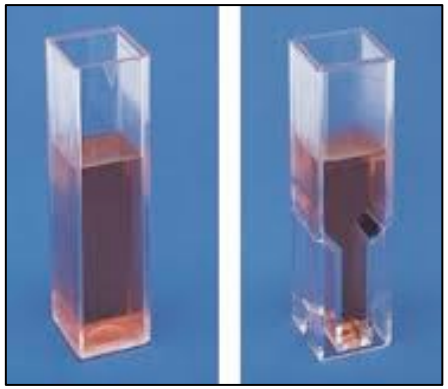
M13 nanowires as battery cathode

phage
AuNP



Li+ ions

Phage titer:



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

- by spectrophotometry

DNA + proteins

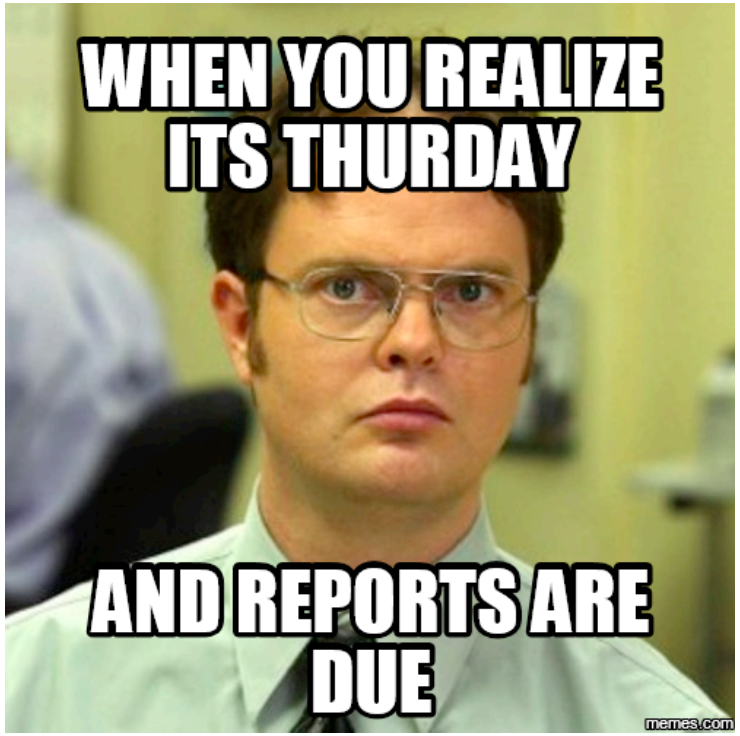
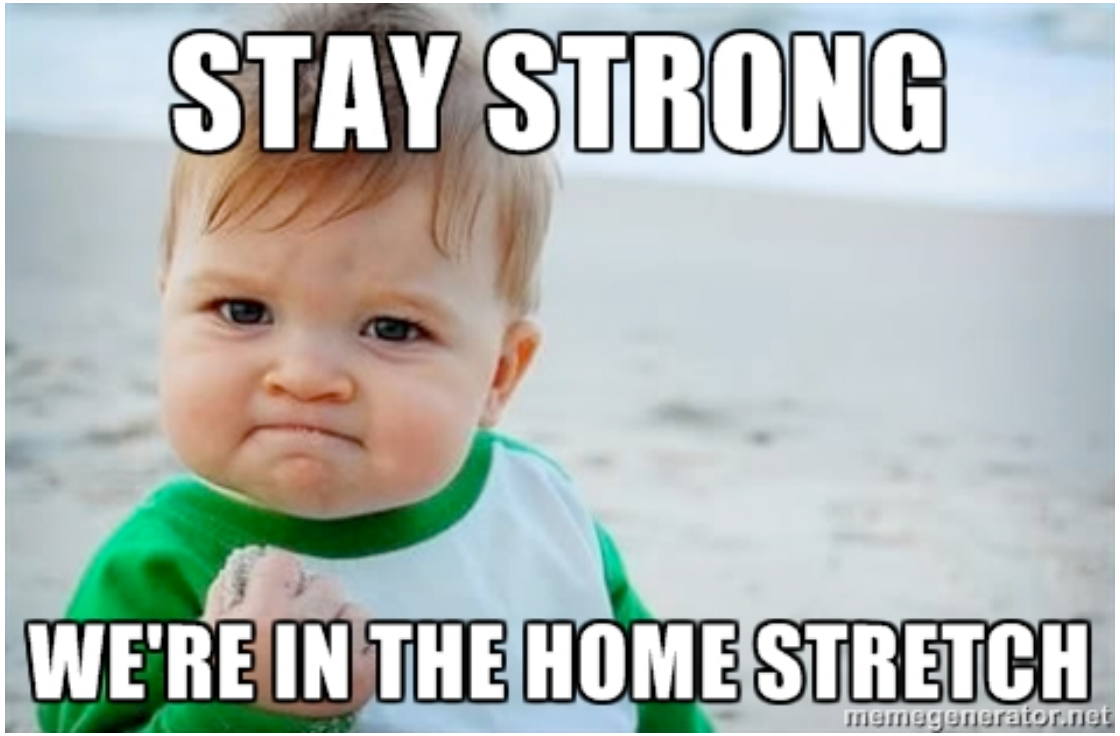
$$\#\ \text{phage / mL} = \frac{(6 \times 10^{16})\,(A269 - A320)}{\#\ \text{bases in phage genome}}$$

7220 bases

background

- quartz cuvettes are expensive!

Today in lab:

Homework for M3D2:
5 research themes of interest to you
Quiz on M3D2!

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