

- **Announcements**
- **Pre-lab Lecture**
 - ❖ **Mod3 Concepts**
 - ❖ **Intro to M13 Virus**
 - ❖ **Intro to Solar Cells Materials**
 - ❖ **Today in Lab (M3D1)**

Announcements

- Introducing... Griffin, TA for Module 3
 - Reflections #2 and #3 due TODAY at 5 pm
 - Quiz next time!
 - Mod 2 research paper
 - returned on 11/19
 - revisions due 11/27 at 5 pm (day before t-giving)
- 1d extension if used Writing Lab
* (SKM) or other resource ok

Module 3 Foundations

- Biology can interface with nano- and micro-scale materials

cells 1-10 μ m

*viruses 0.01-1 μ m

proteins/cmpl. 1-100nm

- Nanoscale materials may have improved or even emergent properties

↓
• elec/mag

• optical

• catalytic

...

* benefit + risk

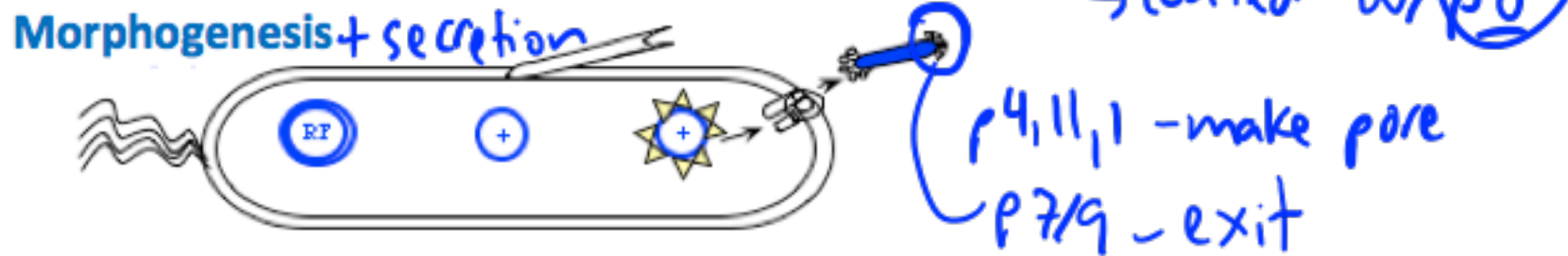
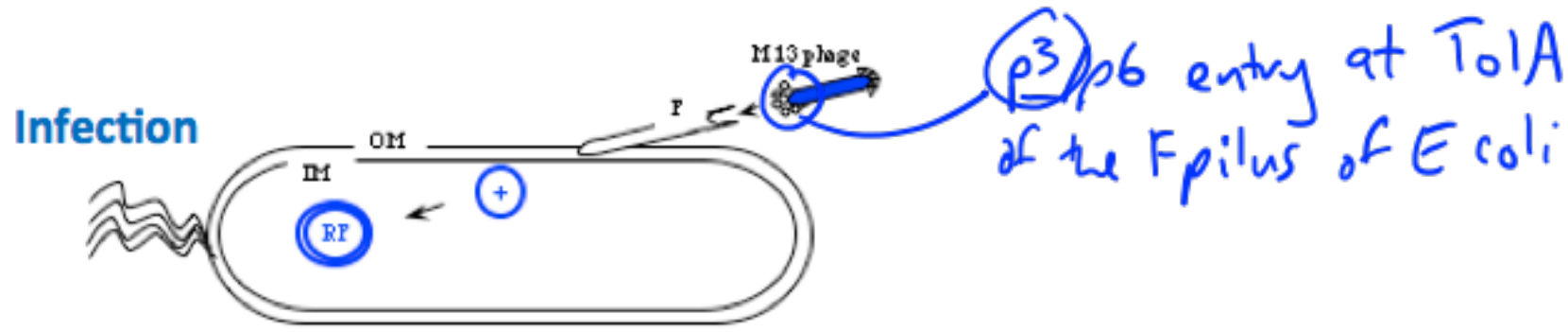
tough to predict
e.g. upon assembly

- Our nanomaterial is a phage!

0.0 μ m



M13 phage life cycle



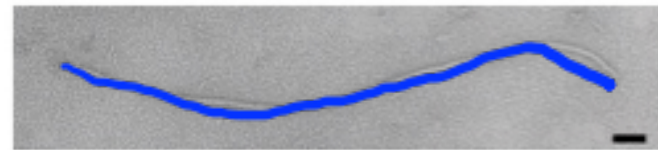
initial ϕ w/in 10^1

Image from Fall 2007 wiki. RF = replicating form

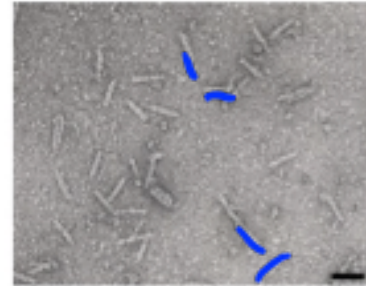
M13 as engineering substrate

- Length of DNA (to be packaged) dictates phage size... w/in limits
- Surface proteins for functional peptide display
- Method: (1) design library (2) binding assay screen

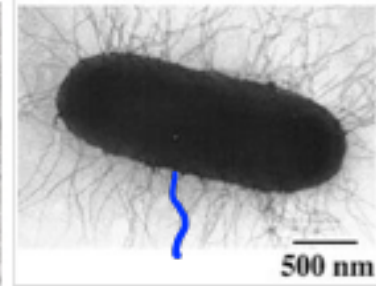
Micrographs from 20.109 wiki



WT
6.4Kbp

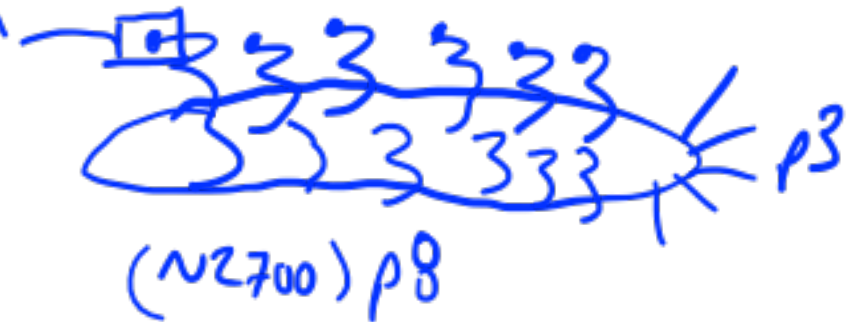


200bp

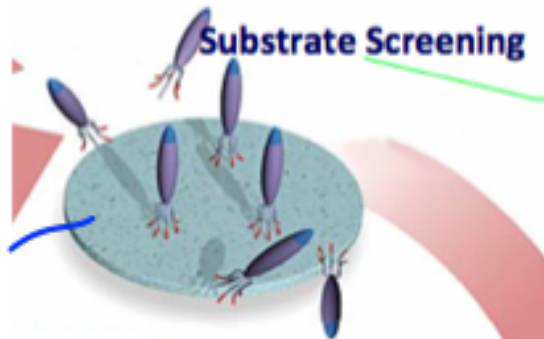


~13Kbp

FBag
for us

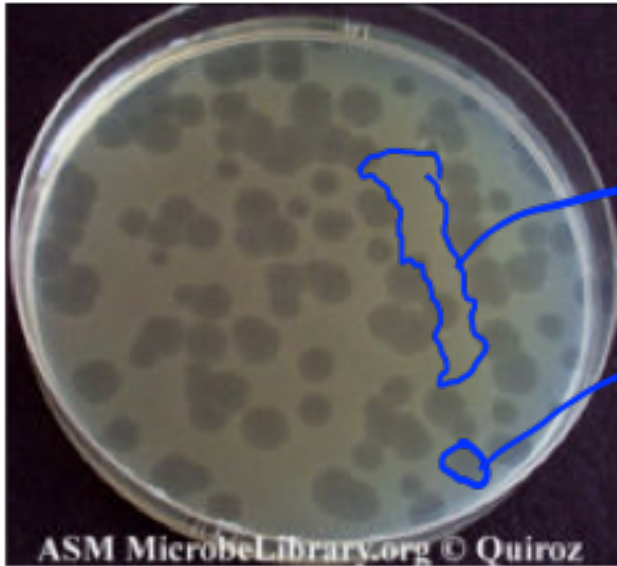


material
of interest



Schematic from A. Belcher

Phage titer: plaque assay or spec.



By plating:

Phage slow *E. coli* growth upon infection

"bawn" - opaque = bacteria
 "plaque" - clear = less dense
 ∴ infected by ϕ
 PFU (cf CFU)

By spectroscopy:

etc. \uparrow biol. content \uparrow A_{260} -DNA
 A_{280} -protein
 $6 \times 10^{16} (A_{269} - A_{320}) \rightarrow$ background

phage particles =

DNA bases in phage genome

for given ΔA , \uparrow genome means \downarrow particles cf bkb:ins w/ EtBr

SWNT-Au/TiO₂ nanocrystal approach

more on ~D4

- Begin today: react phage w/SWNTs *or* gold
 - SWNT ↑ e- collection efficiency
 - Au ↑ usable light collection
- Why bother with phage?
 - surfactant for SWNT
 - bring TiO₂ proximate to SWNT or Au
- Vary *ratio* of phage:(SWNT or Au)
- Next time react w/Ti(OCH(CH₃)₂)₄
- Eventually...
 - TEM observation
 - solar cell assembly

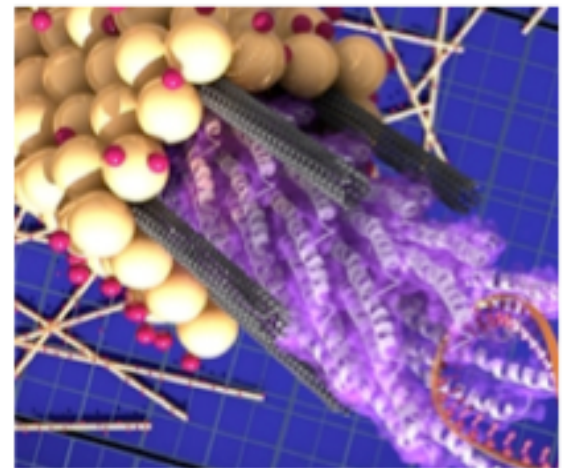


Image: Matt Klug

Today in Lab (M3D1): Workflow

- Prepare phage by precipitation with PEG/NaCl
 - Incubations/spins *alone* are almost 2 h
 - At the end, phage are in the supernatant!!
 - Pellet is *bacteria* → *orient* to know pellet location
- Obtain viral titer
 - *take care with quartz cuvettes!*
- React/dialyze phage w/SWNTs *or* gold
- Downtime: calculation sheet, reflections, FNT, etc.
in advance

Today in Lab (M3D1): Samples

Group (W/F)	Material	Ratio (material:phage)
Red	SWNT	1:1 (SWNT:phage)
Orange	SWNT	2.5:1 (SWNT:phage)
Yellow	SWNT	5:1 (SWNT:phage)
Green	SWNT	2.5:1 (SWNT:phage)
Blue	AuNP	1:1 (AuNP:phage)
Pink	AuNP	1:1 (AuNP:phage)
Purple	AuNP	5:1 (AuNP:phage)
N/A		
White	AuNP	10:1 (AuNP:phage)

- **Au** "easy"
 - Calculate volume Au needed (stock = 5×10^{13} particles/mL)
 - Mix in glass scintillation vial
 - Store in fridge

- **SWNT** "banger"
 - Calculate volume SWNT needed (stock = 20ug/mL)
 - Add phage, SWNT to *prepared* dialysis tubing (cut & soak)
 - Dialyze against NaCl pH 5.3...
 - ↳ SWNT/~~phage~~ electrostatic repulsion
 - ... then pH 10
 - ↳ stabilize, ready for TiO₂!
- **BOTH**
 - Prepare phage stock: *there are 2 kinds, so check!*
 4×10^{13} phage/mL

Slide modified from A. Ramaswamy