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

Announcements

- Introducing… Jackie, TA for Module 3
- Module 3 assessment
  - done as a team
  - novel research proposal
  - define a specific question and an approach to address it
  - downtime in lab during M3 to work on it
  - pre-proposal: written (due M3D4)
  - final proposal: oral *or* written (due M3D6)

Module 3 Foundations

- Biology can interface with nano- and microscale materials

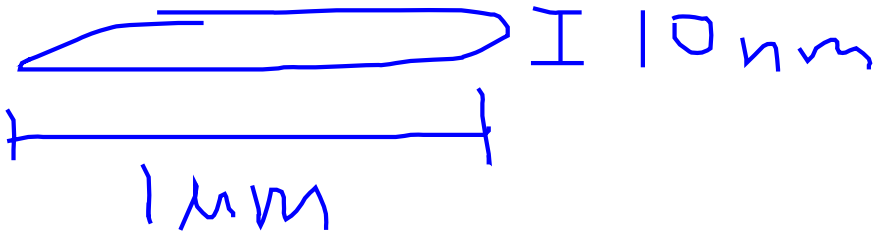
cells 1–10um
viruses 0.01–1um
proteins 1–100nm

- Nanoscale materials may have improved or even emergent properties

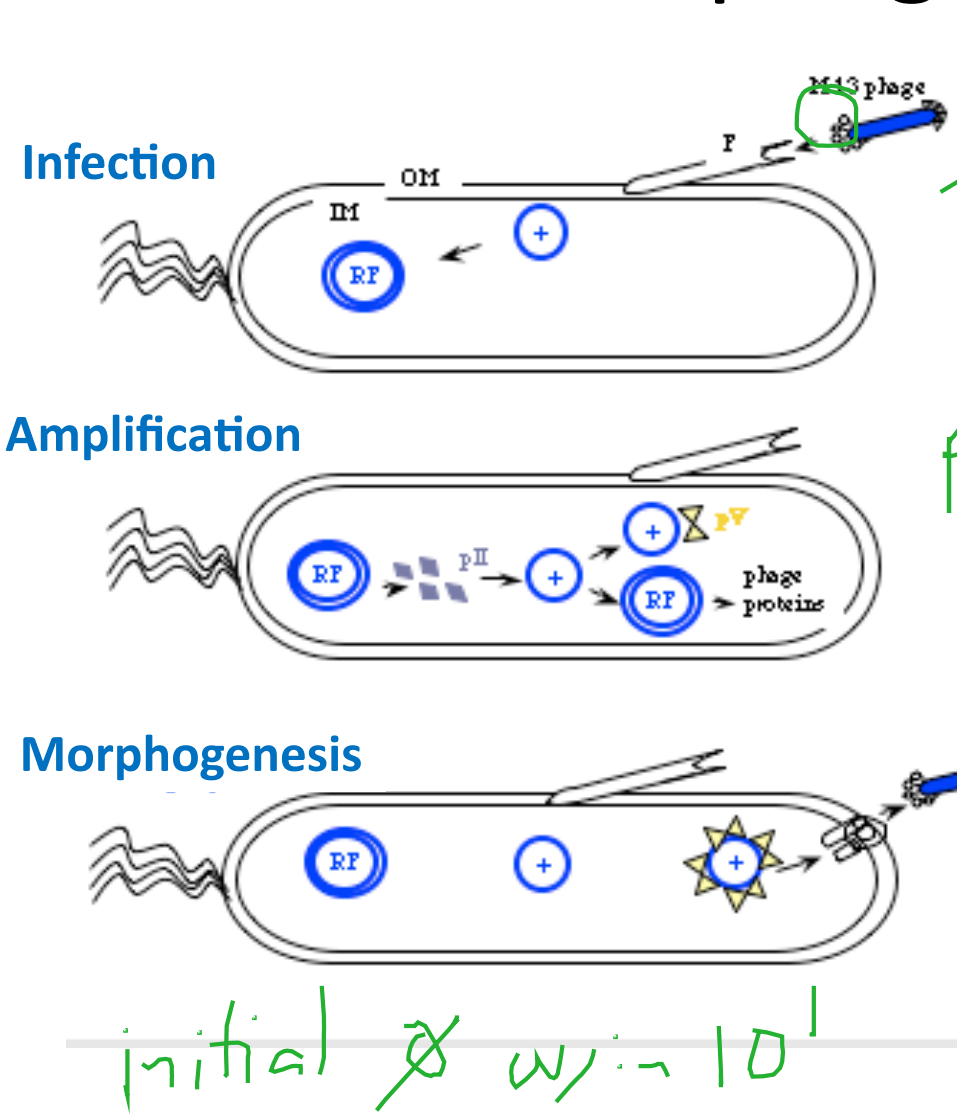
-elec, magnetic, optical, catalytic
also high surface area : volume

★ benefits ★
+
risks

- Our nanomaterial is a phage!



M13 phage life cycle



p3/p6 entry at Tol A @ F pilus of E coli

p2, 5, 10 - replication
ds form, packaged in ss form - coated w/ p8

p7/p9 - exit
p4, 11, 1 make pore

initial ϕ w/ ~ 10^1

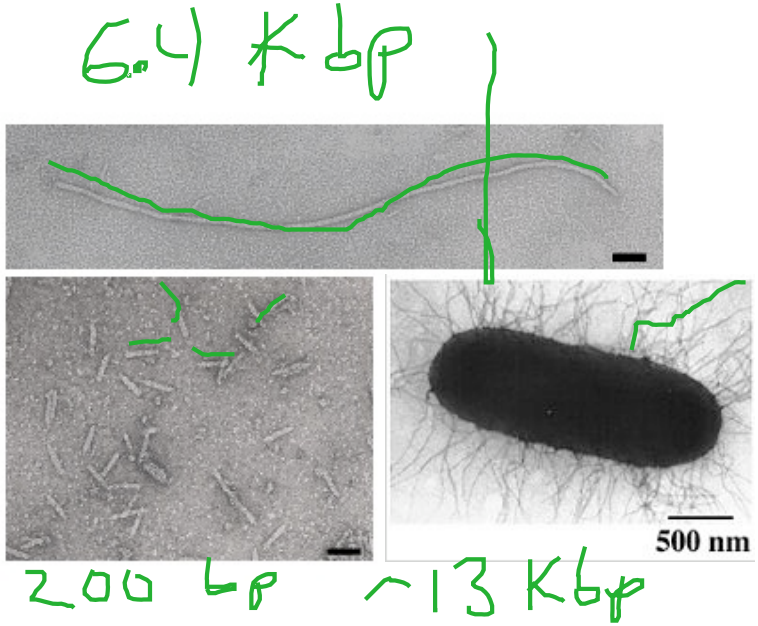
Image from Fall 2007 wiki. RF = replicating form

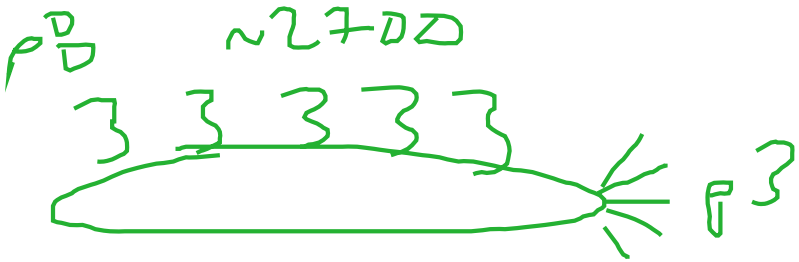
M13 as engineering substrate

Length of DNA (to be packaged) dictates size of phage… w/in limits

Surface proteins can be used for peptide display

Library design and screen via binding assay





p3 pros/cons

+ end-to-end/directional

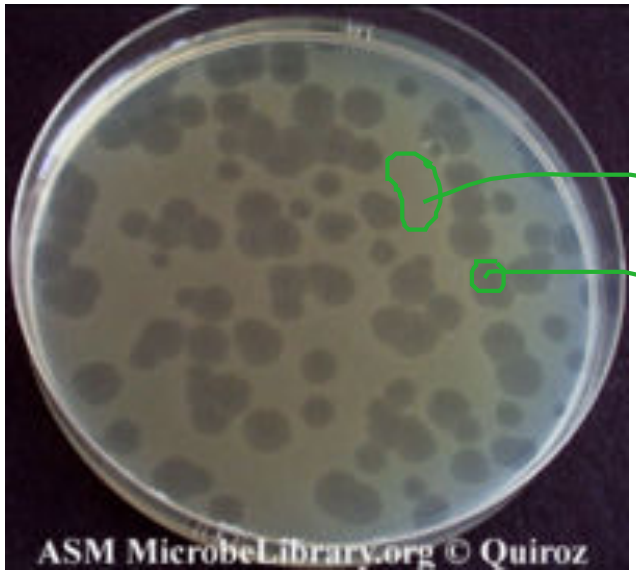
+/- affect entry dynamics

- low copy #

Images from 20.109 wiki

+ longer & more varied peptides

Phage titer: plaque assay or spec.



By plating:

Phage slow *E. coli* growth upon infection

"lawn"-opaque = bacteria

"plaques"-clear = less dense

: infected by Ø

PFU (cf CFU)

By spectroscopy:

- Nucleic acids (peak 260) and proteins (peak 280) can be ~quantified at 269 nm absorbance
- Subtract background at A320

SWNT-Au/TiO2 nanocrystal approach

- Begin today: react phage w/SWNTs or gold
- Vary ratio of phage:SWNT or phage:Au
- Next time react w/Ti(OCH(CH3)2)4
- Why bother?
  - isolated SWNTs, nice paths
  - proximity to TiO_2
- Eventually…
  - TEM observation
  - Solar cell assembly

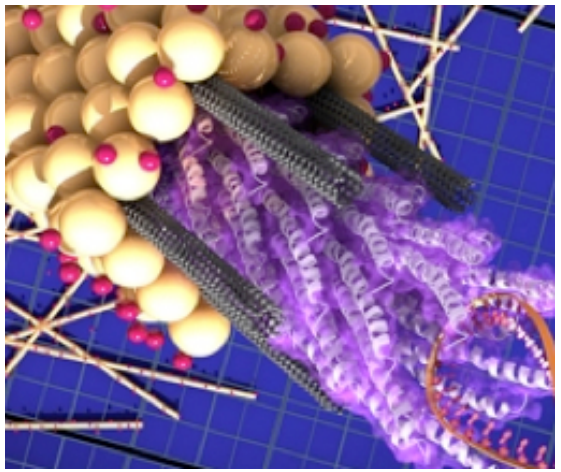


Image: Matt Klug

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 ★know where your pellet is
- Obtain viral titer
  - take care with quartz cuvettes!
- React/dialyze phage w/SWNTs *or* gold

Today in Lab (M3D1): Samples

Part 3: reacting phage with SWNTs or Au

Group	Material	Ratio (material:phage)
MT	SWNT	1:1 (SWNT:phage)
SY	SWNT	2.5:1 (SWNT:phage)
KK	SWNT	5:1 (SWNT:phage)
IS	Au	1:1 (Au:phage)
EA	Au	5:1 (Au:phage)
BMS	Au	10:1 (Au:phage)

1. Calculate volume of Gold needed (stock [Au] = 5x10^13 nanoparticles/ml)
2. Mix in a glass scintillation vial
3. Store in fridge

1. Calculate volume of SWNTs needed (stock=20 ug/ml)
2. Mix in dialysis tubes (label clips of your tubes)
3. Dialyze against NaCl pH 5.3 then 10

Low pH = minimize electrostatic repulsion (phage/SWNT)
High pH = stabilize complex, ready for TiO_2 (↑ nucleation)

Slide modified from N. Kuldell