Biomaterials Engineering

M3D1

11.13.12

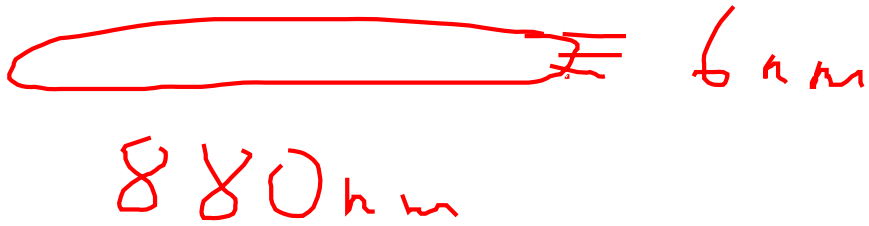
Ideas behind Mod3 experiment

Biology is a nanomaterial

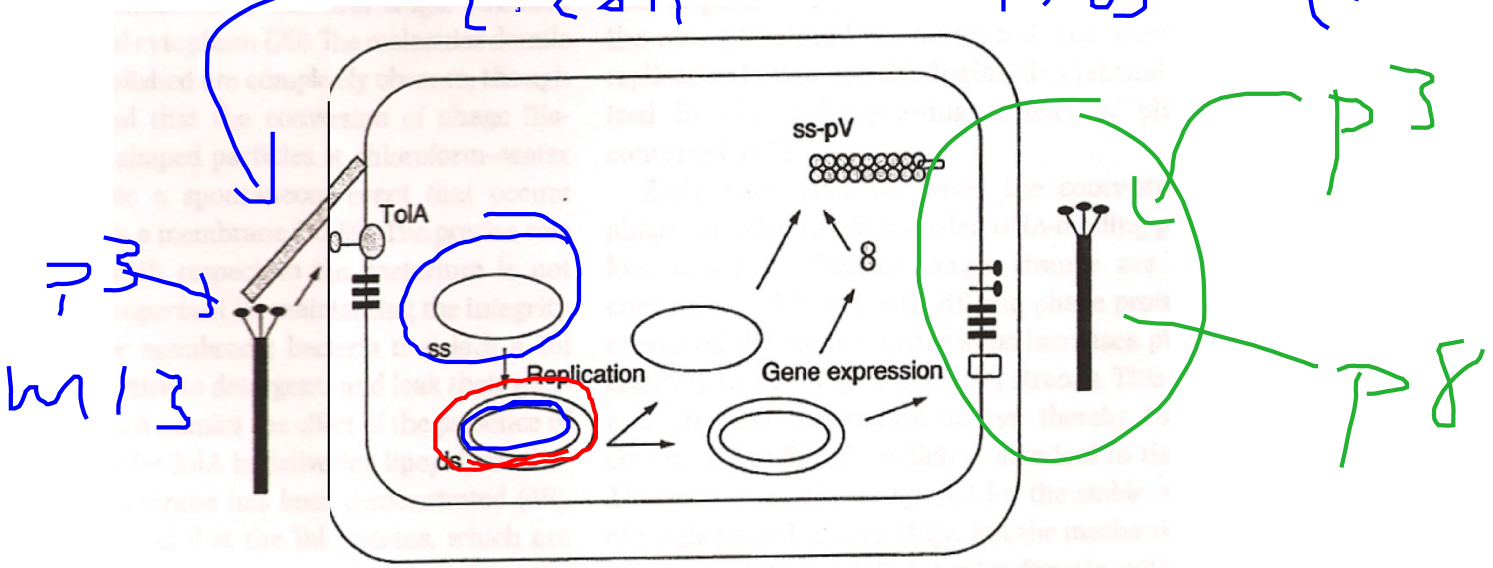
New properties emerge at nano-scale

Our biological nanomaterial is a phage!

M13



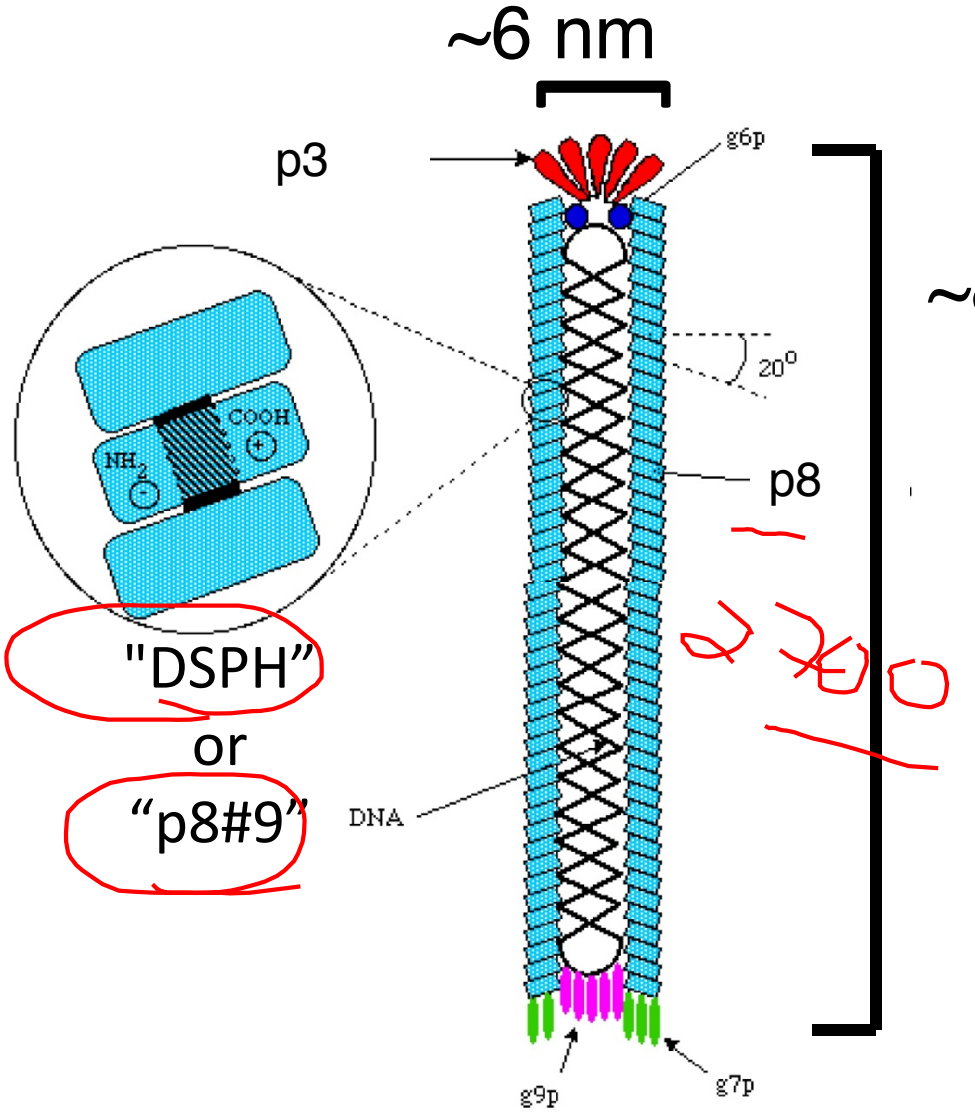
Phage life cycle



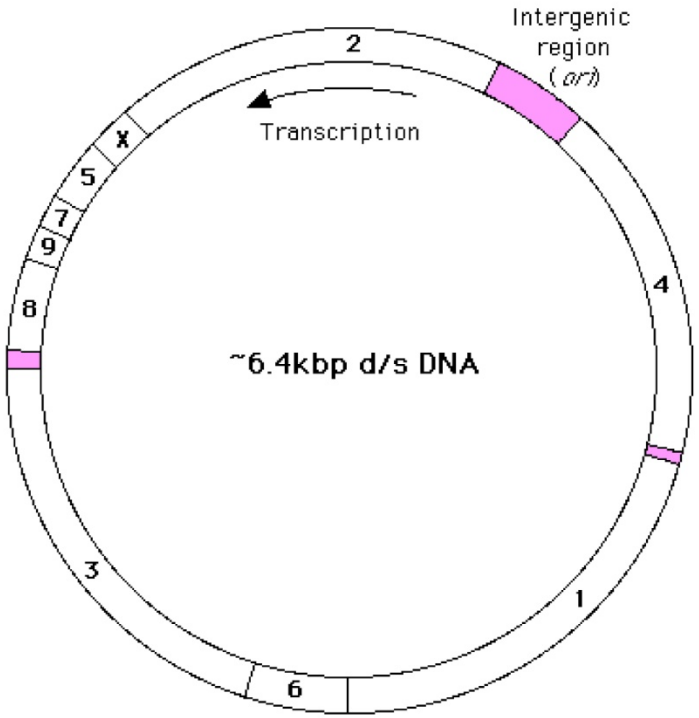
1. Infection
2. Amplification
3. Morphogenesis + release of progeny phage

- new M13 phage particles within 10' post-infection
- 1000 phage/cell within the first hour

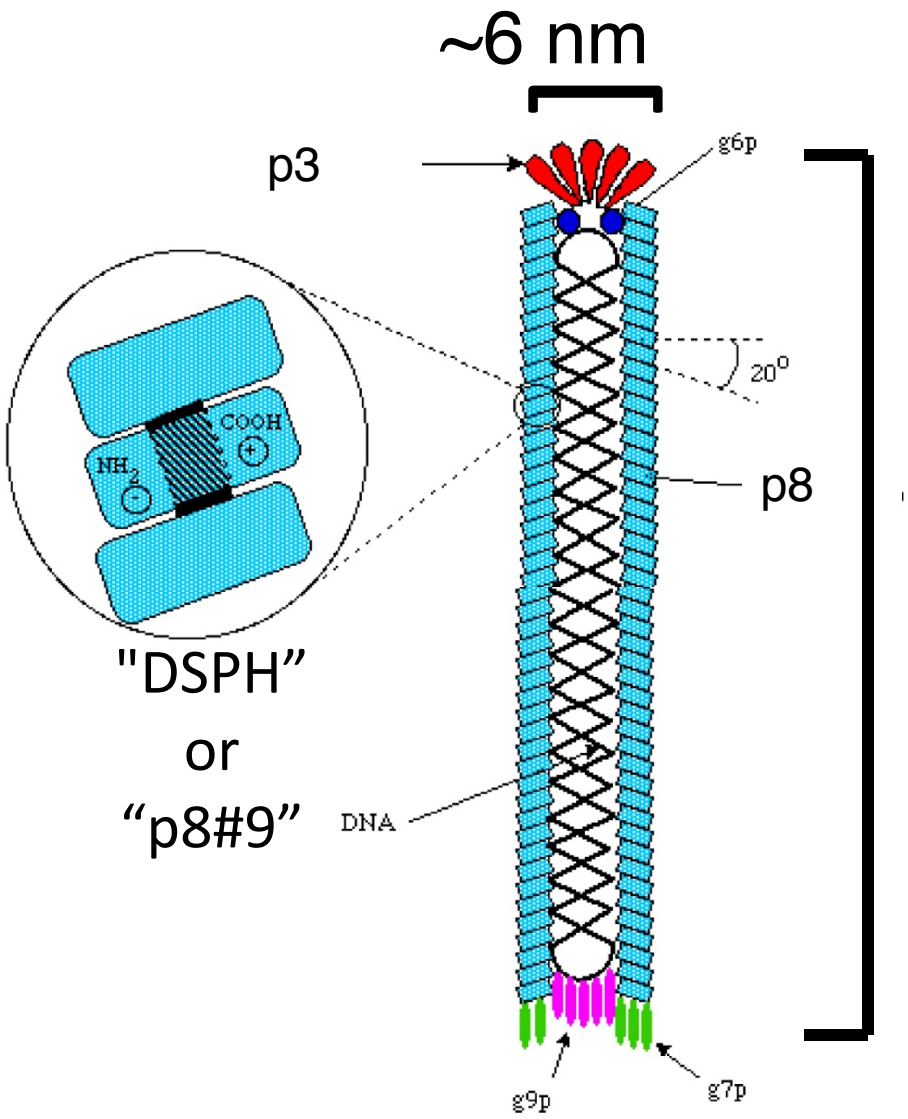
BioMaterials: Starting with “Bio”

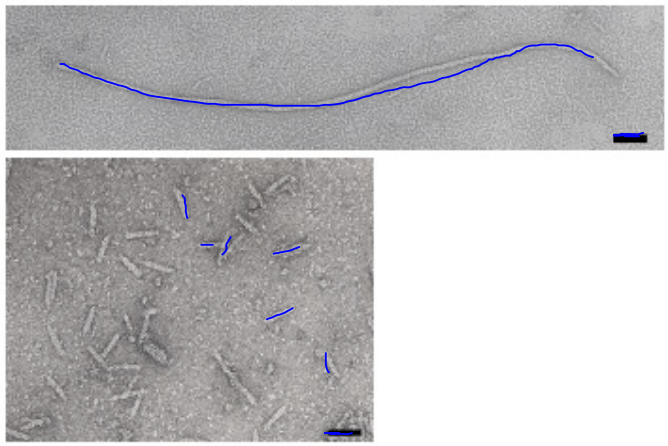


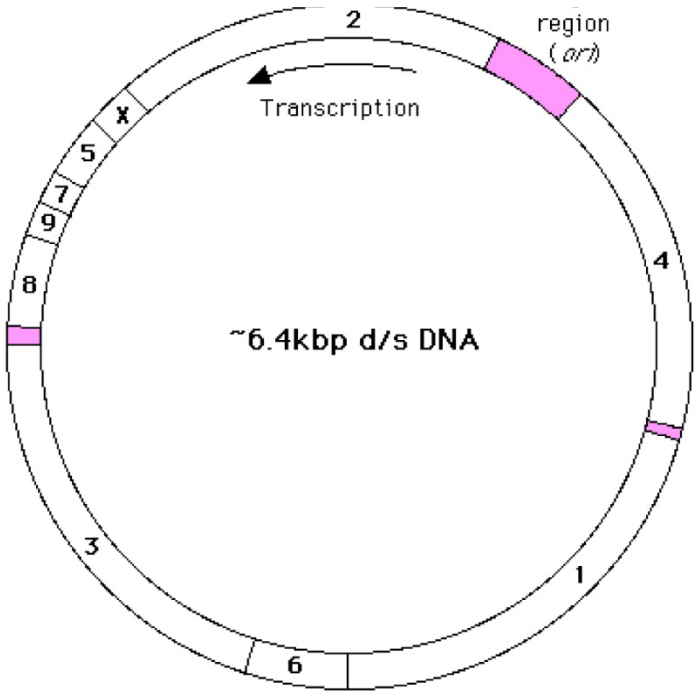
10^10th phage/ml of seawater



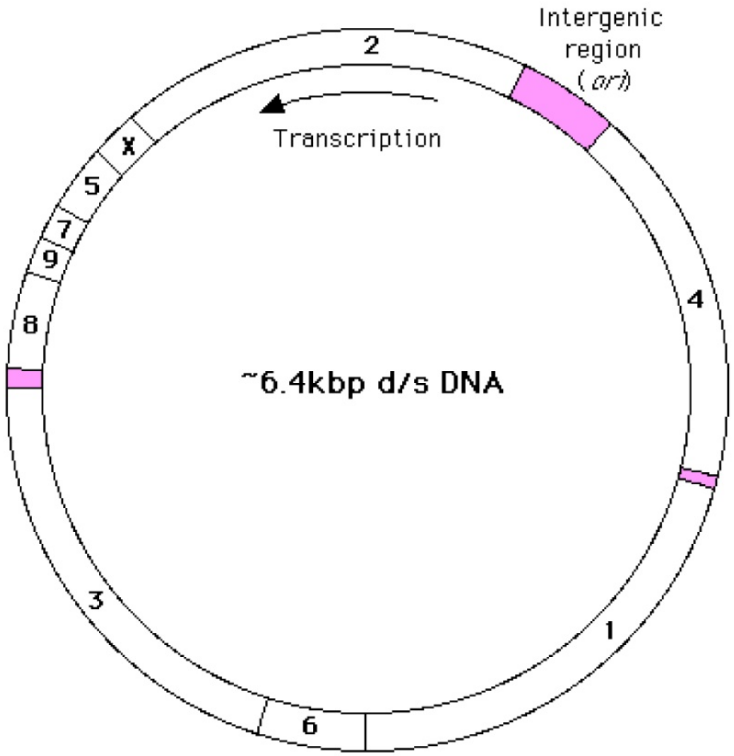
BioMaterials: Starting with “Bio”

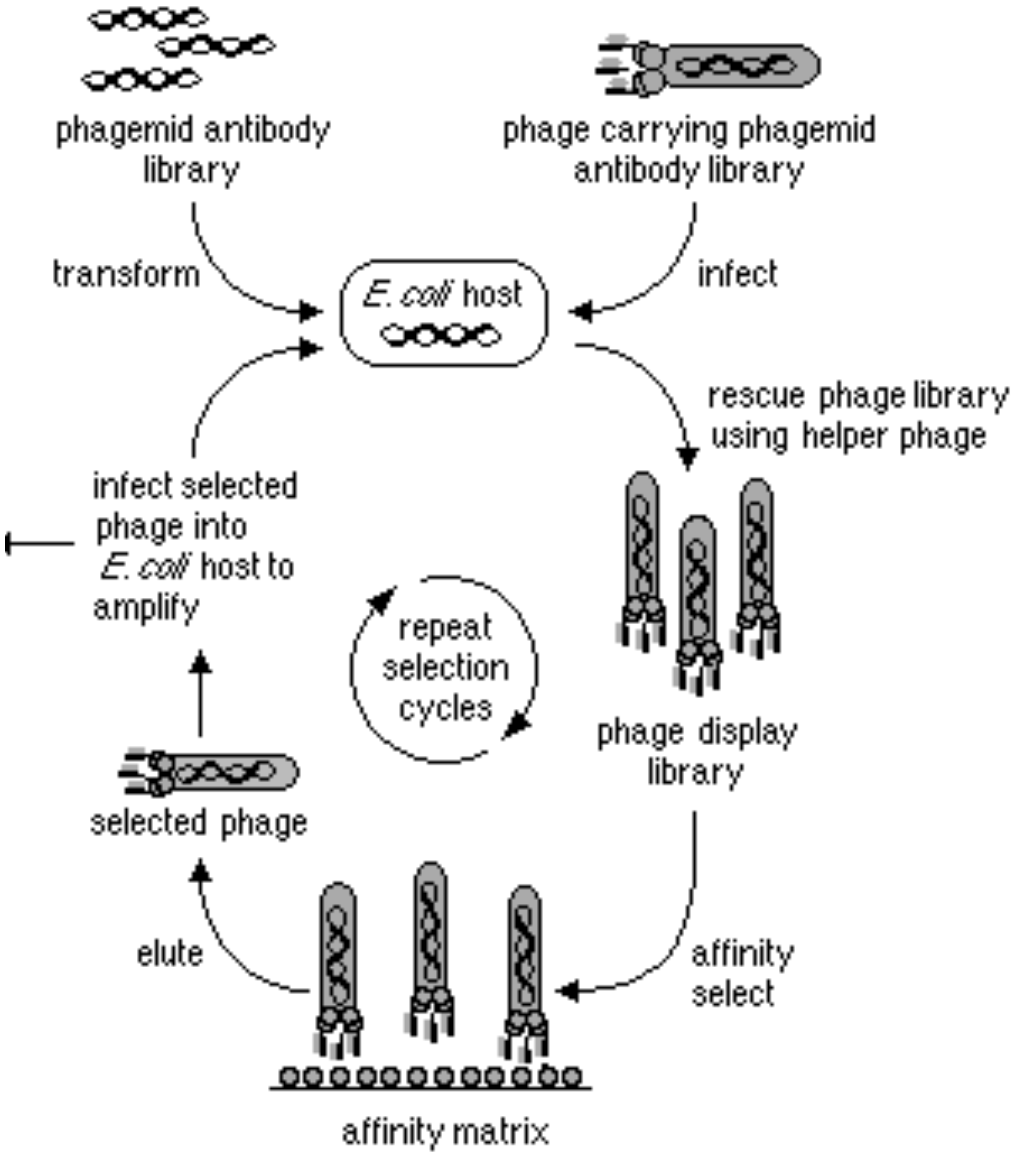




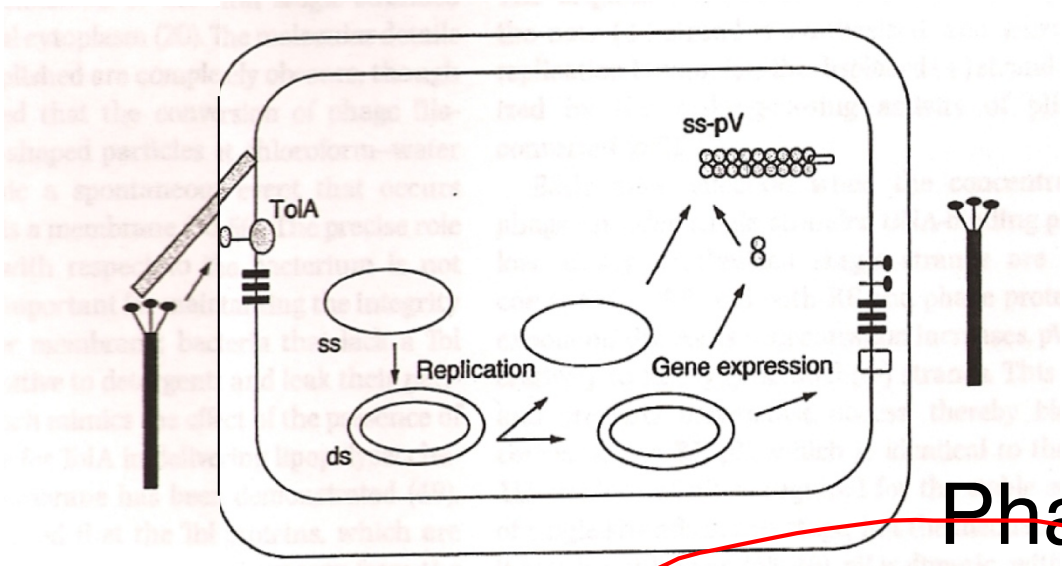


Phage don't normally bind SWNTs or Au. How did Angie's lab find these specialized phage?

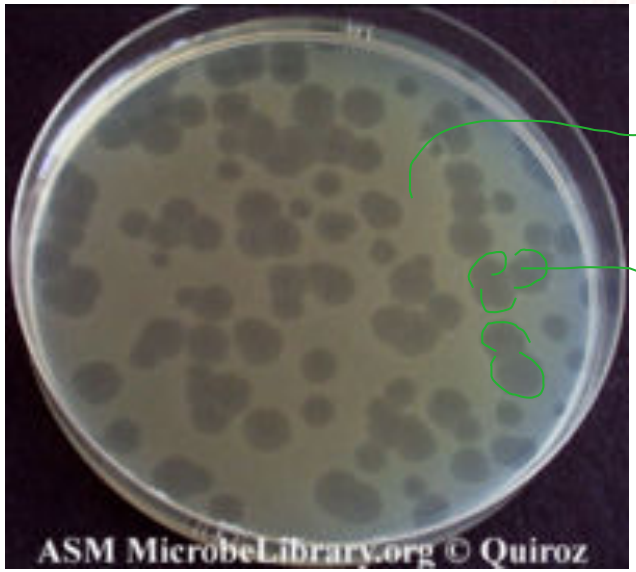




Counting Phage Particles



PFU =



Phage/ml =

$$\frac{(6\times10^{16})(Abs_{269}*Abs_{320})}{\#\text{bases in phage}}$$

Abs_{269} = abs from protein +DNA

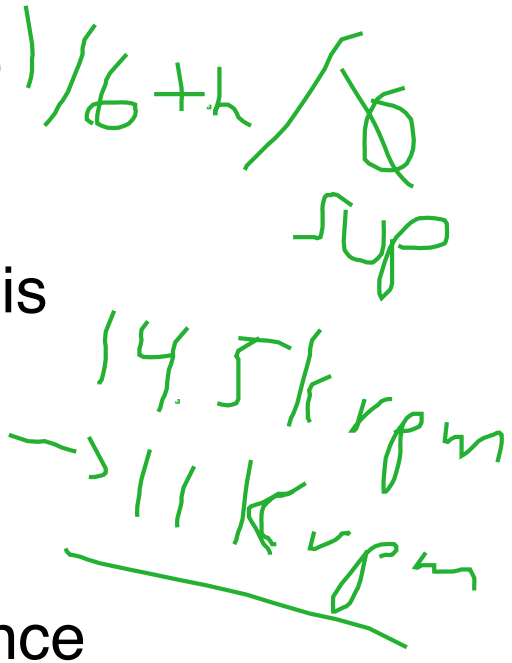
Abs_{320} = baseline

Phage is 6400 bases

Parts 1 + 2 of your experiment today

<u>Phage purification</u>

- Harvest phage infected cells. Phage in SUPERNATANT!
- Concentrate by precipitation (+PEG/salt)
- Pellet may not be visible…have faith.
- Each team will test a variation for synthesis



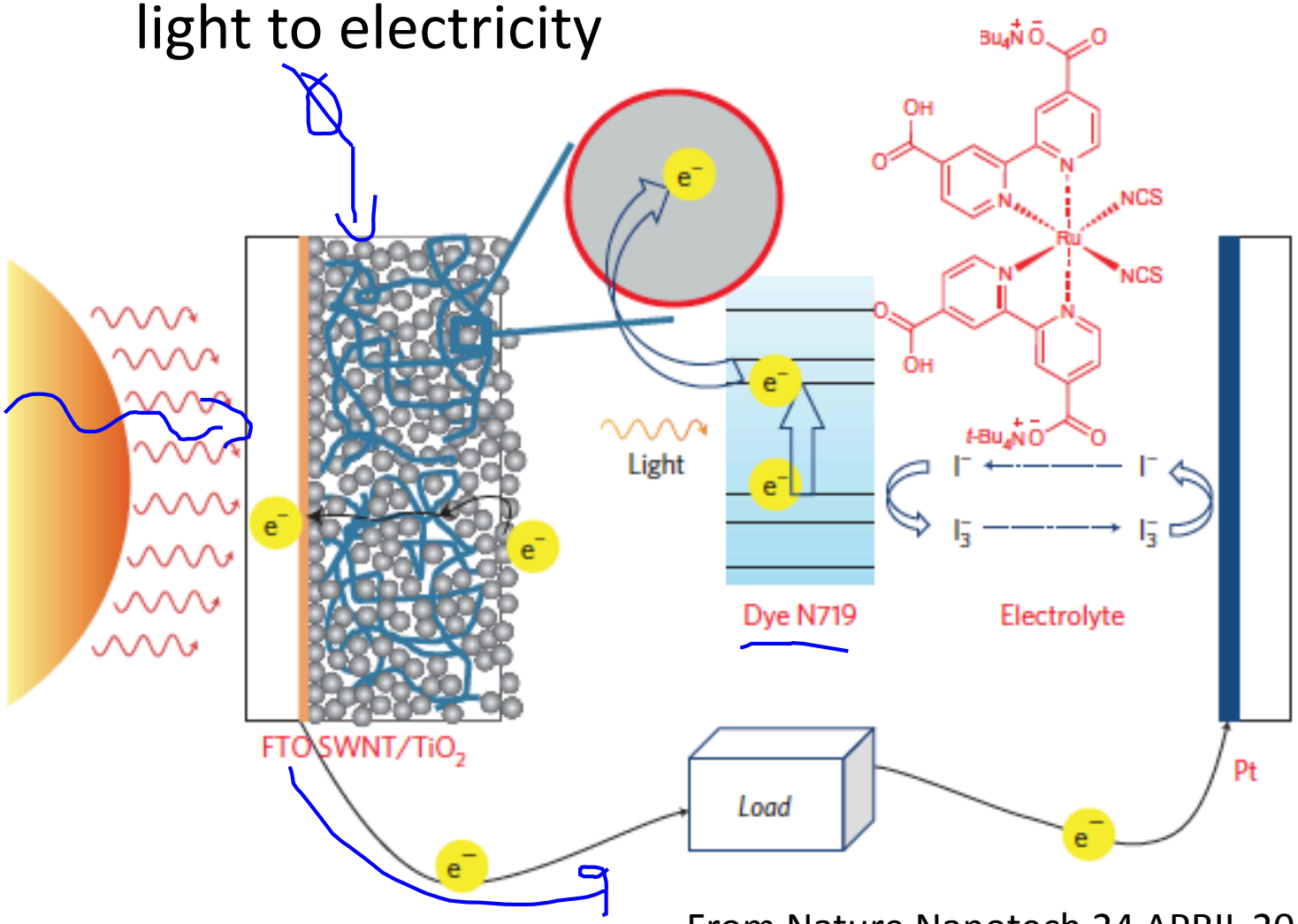
<u>Measurement of phage concentration</u>

- Use quartz cuvettes
- Dilute 1:10 in TBS and measure Absorbance
- Calculate volume needed for 4x10^13 phage

  (want this volume btw 0.5 ml and 5 ml)

BioMaterials: now for "materials"

Photovoltaic device: converts light to electricity



From Nature Nanotech 24 APRIL 2011

Phage provide architecture for SWNTs or Au

SWNTs have different amounts of metallic and semiconducting materials to short circuit electron paths

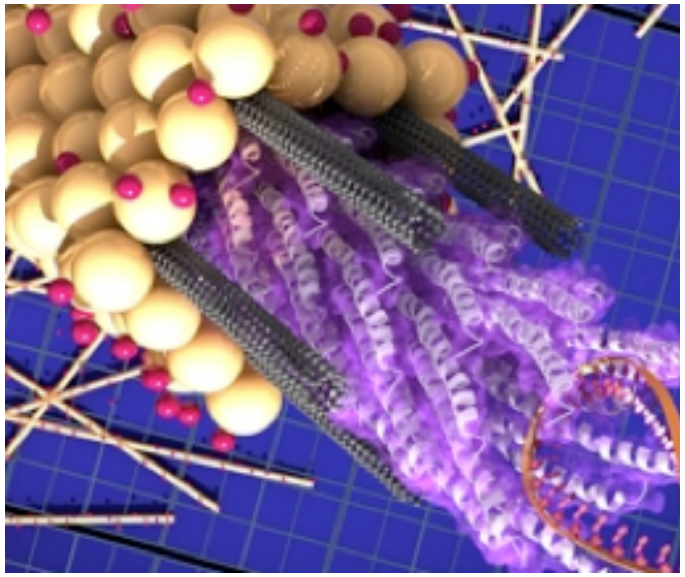
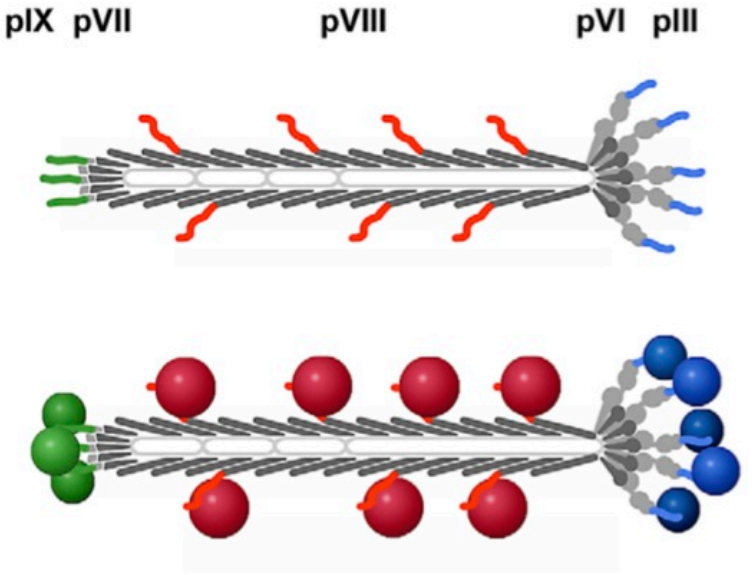


Image from MIT news



Flynn, *Acta Materialia* 51, 5867-5880 (2003)

- Materials provide solvent exposed surface for TiO2
- Unbundle SWNTs

Part 3: reacting phage with SWNTs or Au

Group	Material	Ratio (material:phage)
red	SWNT	1:1 (SWNT:phage)
orange	SWNT	2.5:1 (SWNT:phage)
yellow	SWNT	5:1 (SWNT:phage)
green	Au	1:1 (Au:phage)
blue	Au	5:1 (Au:phage)
purple	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

Module 3 Celebrations of Learning [edit]

Note: titles shown below are links to follow for more detailed information about each assignment

Written Research Pre-Proposal, using this template [edit]

concentration	% of final grade	submit	due	individual/partner
both	10	OWW page printed and brought to class	**M3D4** 11.29.12, 11AM	partner

Oral Presentation of Research Proposal [edit]

concentration	% of final grade	submit	due	individual/partner
oral communication concentration	15	Stellar	**M3D6** 12.06.12 or 12.07.12, 1PM	partner

Written Research Proposal [edit]

concentration	% of final grade	submit	due	individual/partner
written communication concentration	15	Stellar	**M3D6** 12.06.12 or 12.07.12, 1PM	partner