

Mod 3 Day 1: Biomaterials Engineering

Growth of Phage Materials

11/12/2013

- 1. M13 bacteriophage – our nanomaterial (spoiler alert)**
- 2. Phage titer assay**
- 3. React phage with SWNTs or Au**

Stuff!

- Two reflections are due today:
 - Journal Club & Mod 2 paper experiences
- Quiz next time!
- Mod 2 papers will be returned on 11/19, revisions are due on 11/27 at 5pm

Module 3 motivation

- Biology interfaces with nano- and microscale materials!
- Engineered nanomaterials
- In this context: bacteriophage is our nanomaterial!
 - Natural, self-assembling properties

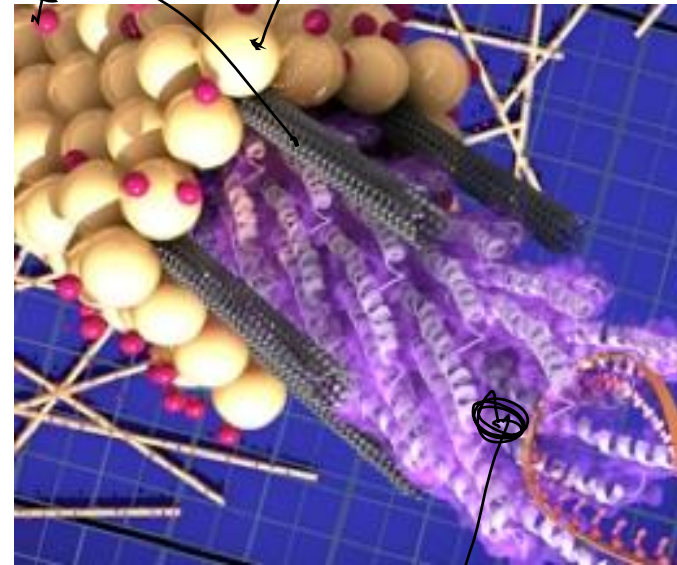
Overview

- Goal: Improve the photon-current efficiency of solar cells!

Au & SWNT ←
Single Walled C
Nanotubes

↳ Efficient e^- paths.

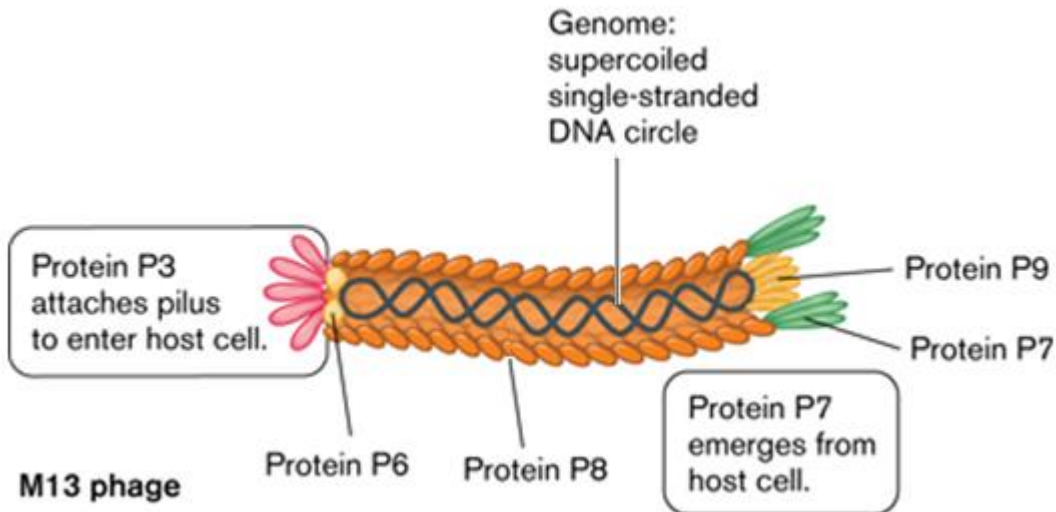
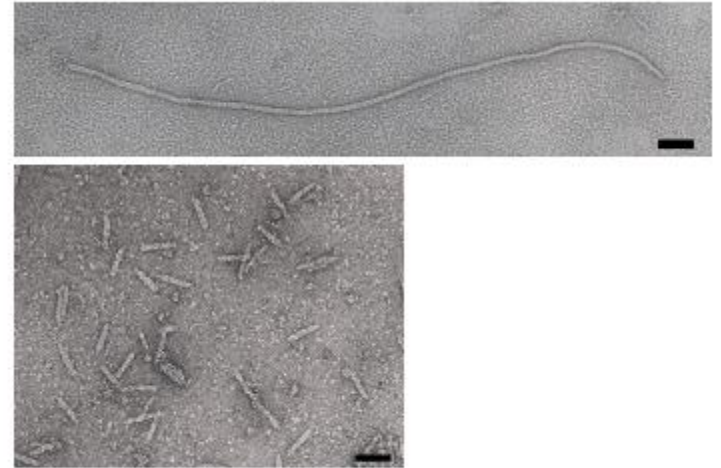
Today
Phage to assemble SWNT/Au



Phage (p8)

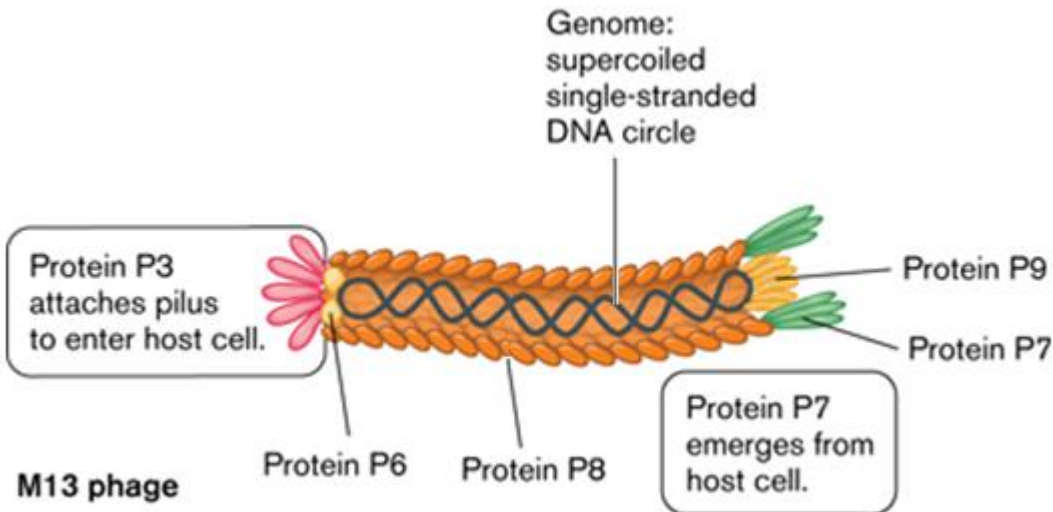
M13 Phage Design: Genome

- Genome encased:



M13 Phage Design: p8

- Genome is wrapped in a protein coat – p8

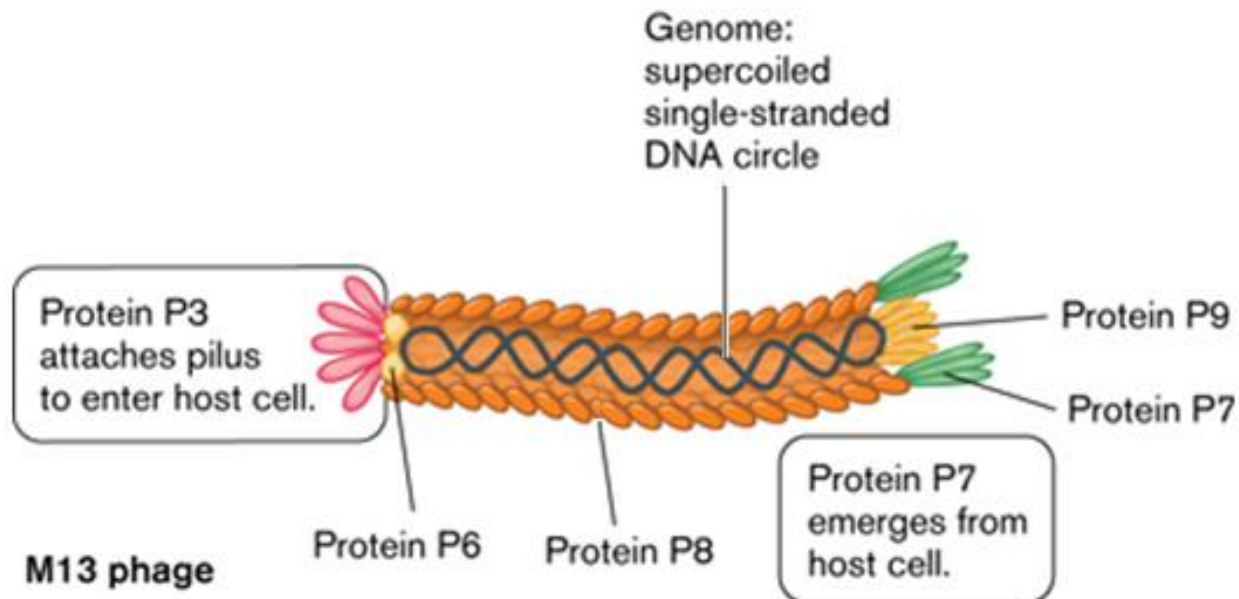


Two M13 clones!

- 1) "DSPH" –
- 2) "p8#9" –

M13 Phage design

- p3 minor coat protein & p6 accessory protein
- p9 minor coat protein & p7 accessory protein



M13 Phage life cycle

1. Infection:

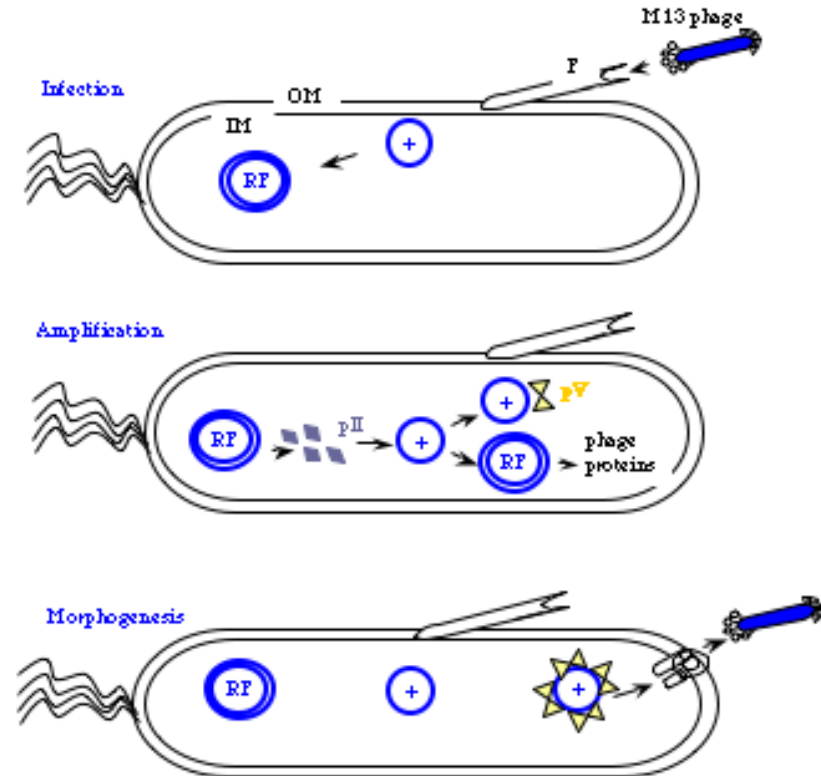
Infection to Secretion in 10 minutes!
1000 new phage per cell in first hour.

2. Amplification!

Infective Form to Replicative Form:

Packaging prepared:

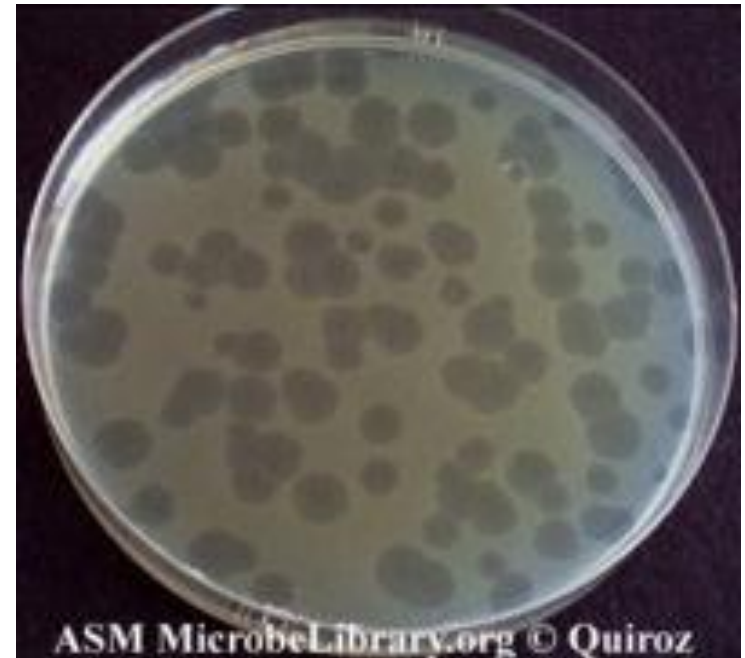
Morphogenesis/Secretion:



Phage titer assay

- Count phage particles!

$$\# \text{ phage particles per mL} = \frac{(6 \times 10^{16})(A_{269} - A_{320})}{\# \text{ DNA Bases in the phage genome}}$$



Complex phage with SWNTs or Au

Group (T/R)	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	5:1 (SWNT:phage)
Blue	AuNP	1:1 (AuNP:phage)
Pink	AuNP	5:1 (AuNP:phage)
Purple	AuNP	5:1 (AuNP:phage)
Gray	AuNP	10:1 (AuNP:phage)
White	AuNP	10:1 (AuNP:phage)

Calculate volume needed for
 4×10^{13} phage/mL

- SWNT
 - Calculate SWNT needed from stock of 20ug/mL
 - Mix in dialysis tubes
 - Dialyze against NaCl pH 5.3 then 10
- Au
 - Calculate volume Au needed from stock 5×10^{13} nanoparticles/mL
 - Mix in glass scintillation vial
 - Store in fridge

Today

- **Goals:**
- Prepare phage using PEG/NaCl precipitation
 - Phage are in the supernatant!!!
 - Pellet is.....
- Viral titer
 - Clean quartz cuvettes after use
- Complex phage with SWNT/Au

Mod 3 Assignments

- **Research Proposal – Dec 10th**
 - Identify a topic of interest, gather relevant background information, understand what you read
 - NEW research question! [not your UROP work]
 - 12 minute talk describing background, research problem and goals, proposed methods, expected results, resources needed, and societal impact.
- **Mini-Report – Due Dec 5th (5pm)**
 - Not as bad as Mod 2!
 - Background & Specific Approach, Results/Data Interpretation, Future Work
 - Schematic, appropriate data figures from each step