

3 Ideas Presentation

New Foundational Advances

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Artifical differentiation

Programmable cells based on absolute position

Possible Applications

Artificially Grown Organs



Possible Applications

Cellular Assembly Lines



Possible Applications

Multicellular Organisms



Competing Technologies

- Fine reactors



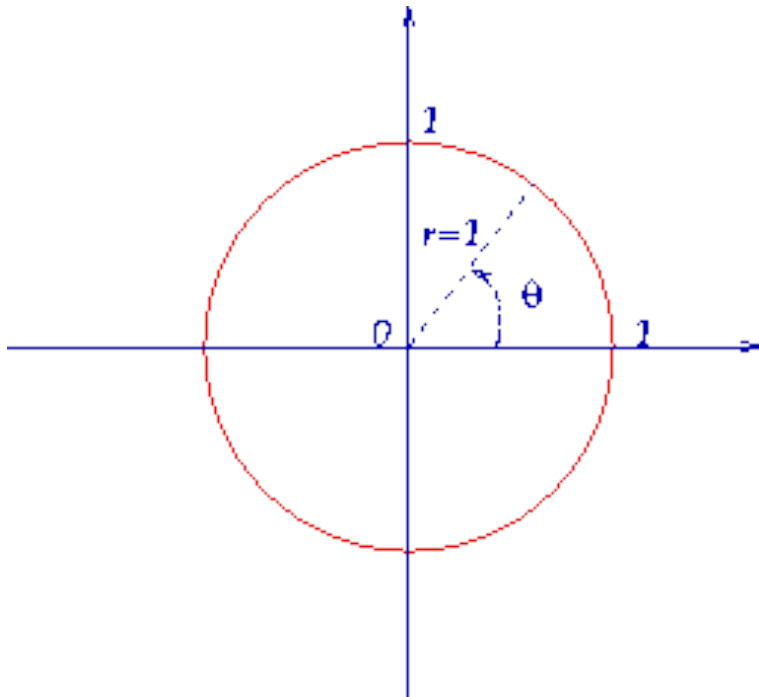
- Prosthetics



Ph: Daniel Hambury

Knowns

Polar coordinate
system



Determination of R



Unknowns

Chassis



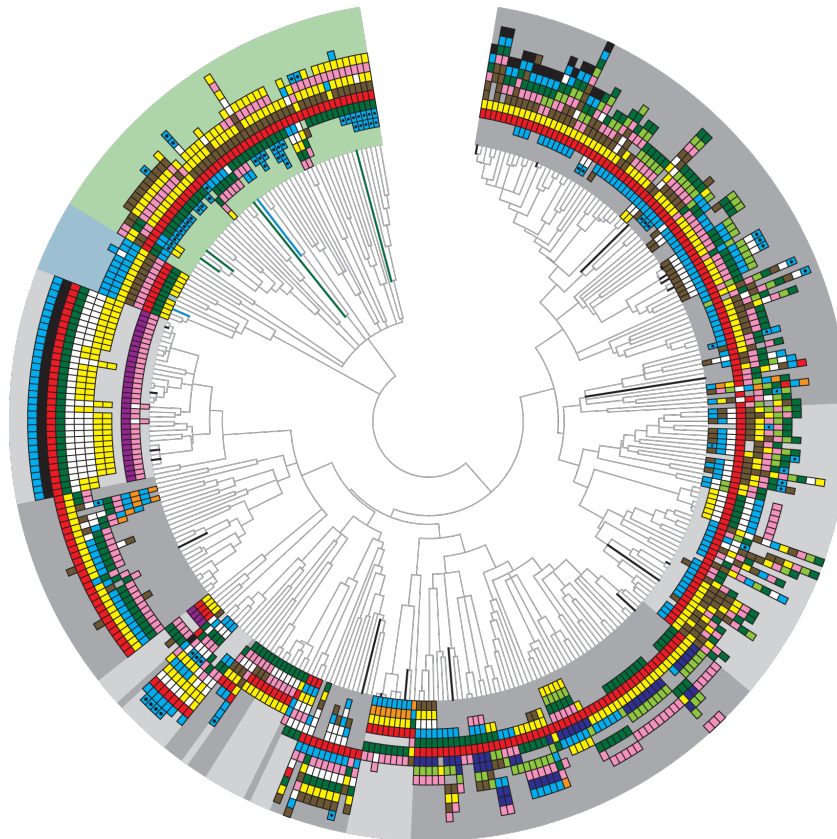
Determination of
Theta

θ

Unknowns

Signalling Molecule

Cellular Memory

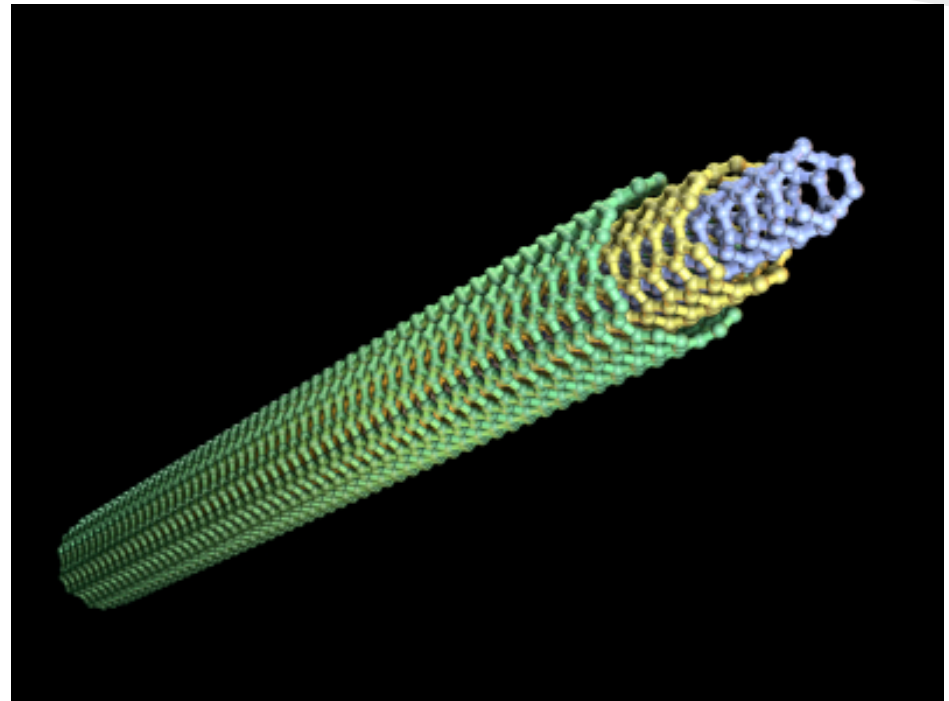


Nanodevices and Synthetic Biology

Can one create inorganic structures inside the cell?

What is a Nanodevice?

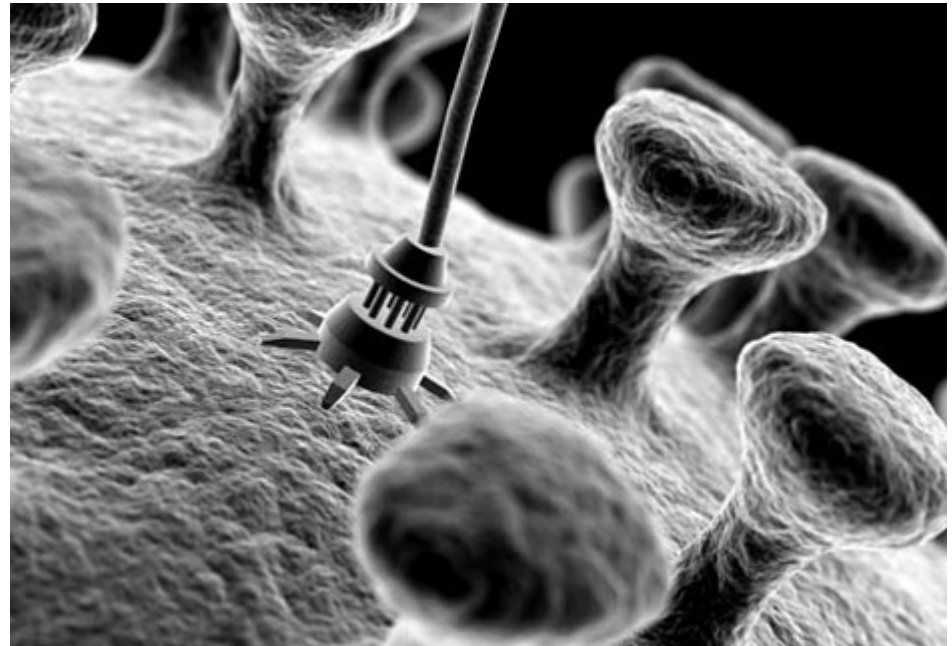
- Structures on a tiny scale
- Usually made from carbon
- Examples:
Nanotubes,
Buckyballs



Idea and its Importance

It is difficult to manufacture extremely precise nanostructures. However, we can genetically program cells to build them.

Nanodevices have many potential benefits in medicine, manufacturing, environmental sustainability.

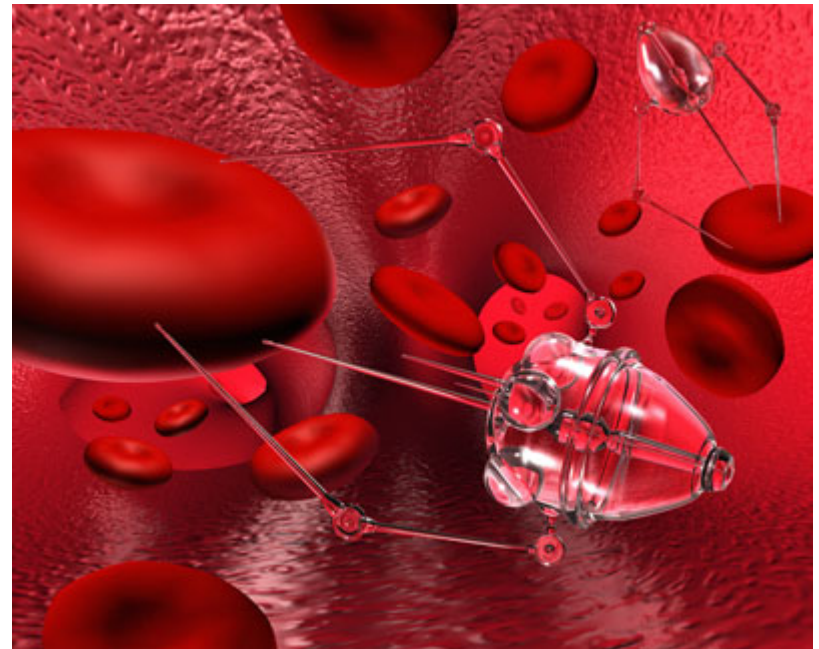


Impact- In Medicine

Can have significant benefits to medical imaging/ detection of disease/ cure of disease.

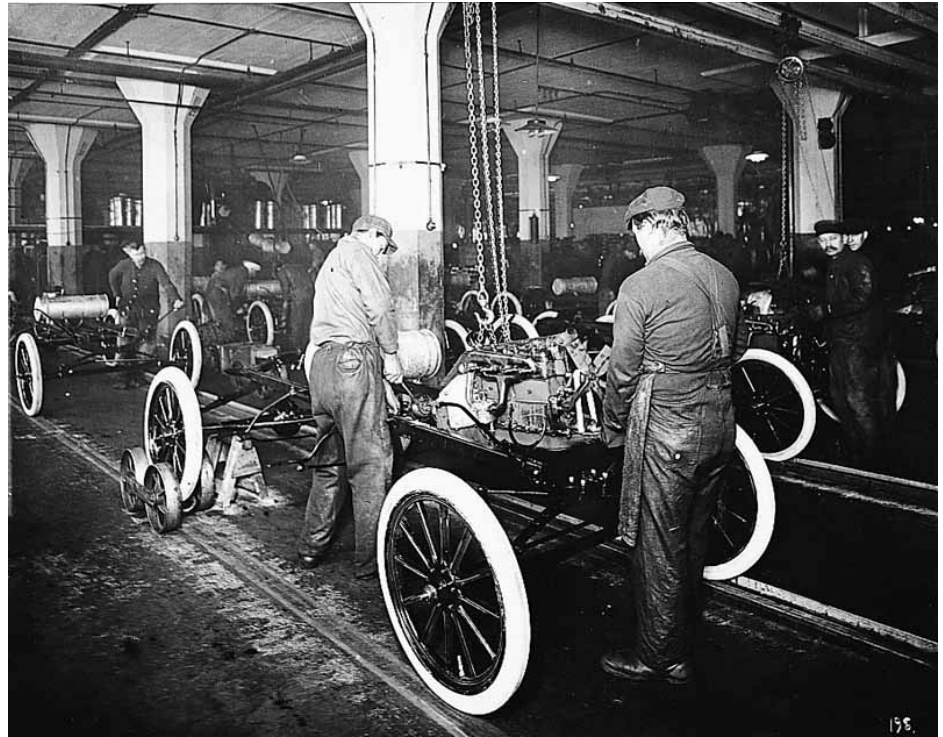
Cells could become near self-sufficient in fighting disease by producing relevant nanodevices- revolutionary in treating diseases.

Potentially be a cheaper way of manufacturing nanodevices- can be affordable and ubiquitous in providing medical care.



Impact- In Manufacturing

- Factories that can grow and reproduce themselves
- Highly accurate
- Less parts
- Cheap



Competing Technologies

National Cancer Institute
is currently doing research to produce
many types of nanodevices

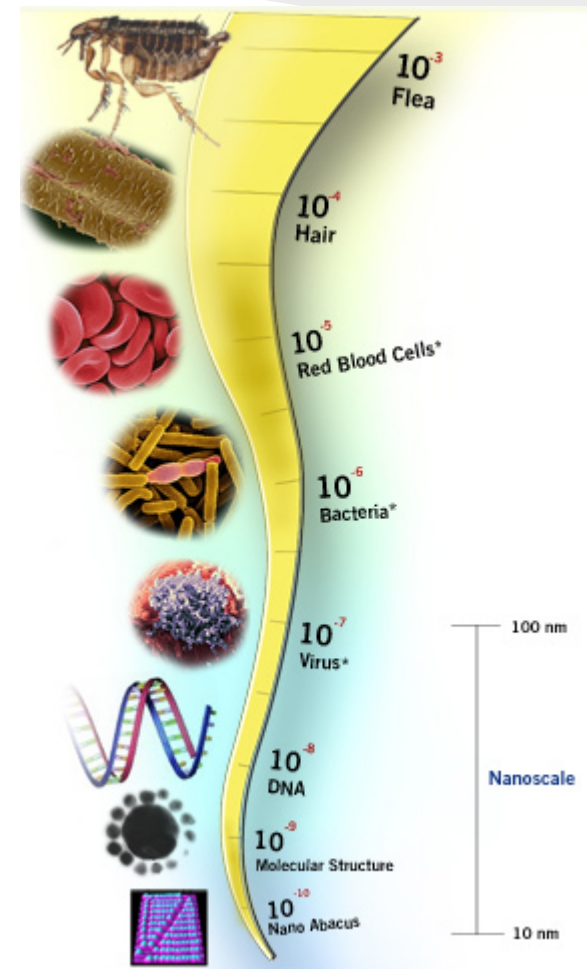
Angela Belcher, Biomolecular Materials
Lab

Used other biotemplating applications
using viruses, to assemble single-
walled Carbon nanotubes together



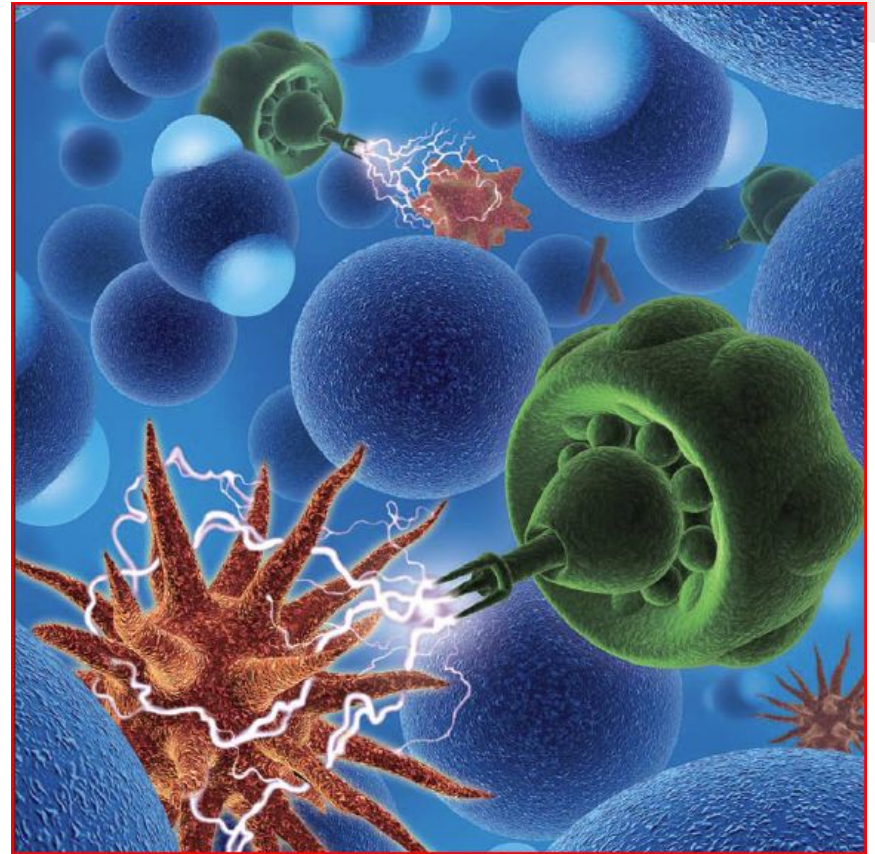
Knowns

- 1) This is possible!
- 2) We can manufacture specific enzymes for nanodevice assembly
- 3) Scale is a major factor to consider.



Unknowns

- 1) Durability and longevity of nanodevices?
- 2) Bringing nanodevices from design to function
 - Prokaryotes vs Eukaryotes?
 - Through the Ribosome?
- 3) Implications in medicine



Programmed Cell Death

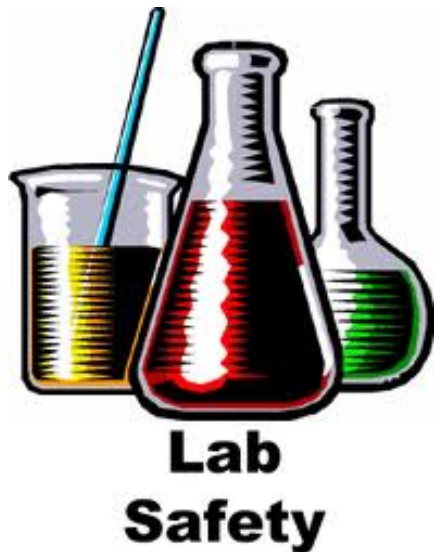
"Failsafe Apoptosis"

Problem

- Genetically engineered bacteria can pose a danger to the environment.
 - Even if the cells cannot survive, their modified DNA can be picked up by other cells through horizontal gene transfer.
- Create a pathway within the bacteria to trigger programmed cell death while also shredding the cell's DNA.



Impact

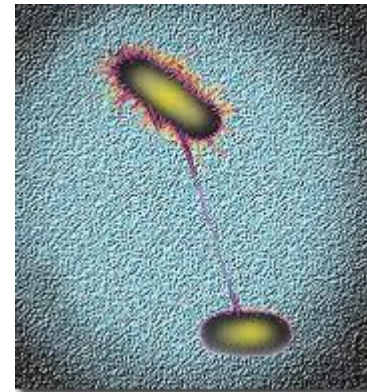
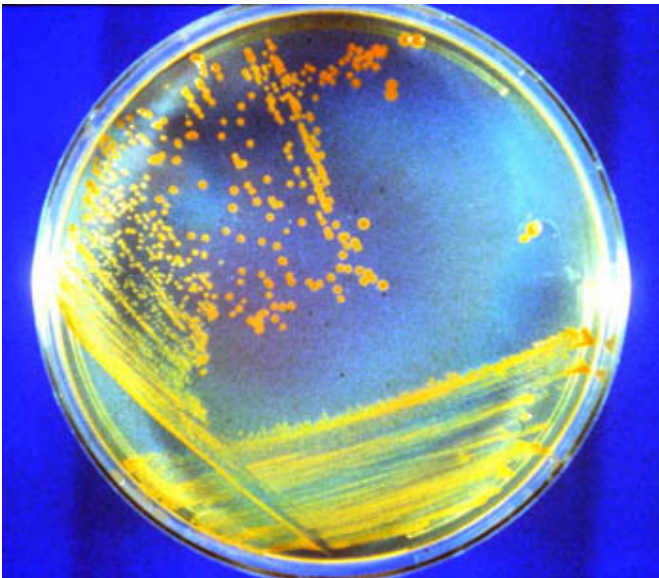


- Labs working in synthetic biology need to be careful about having modified organisms leaving the lab.
- This project would make experiments safer by adding a layer of redundancy if modified organisms were accidentally released

Competing Technologies

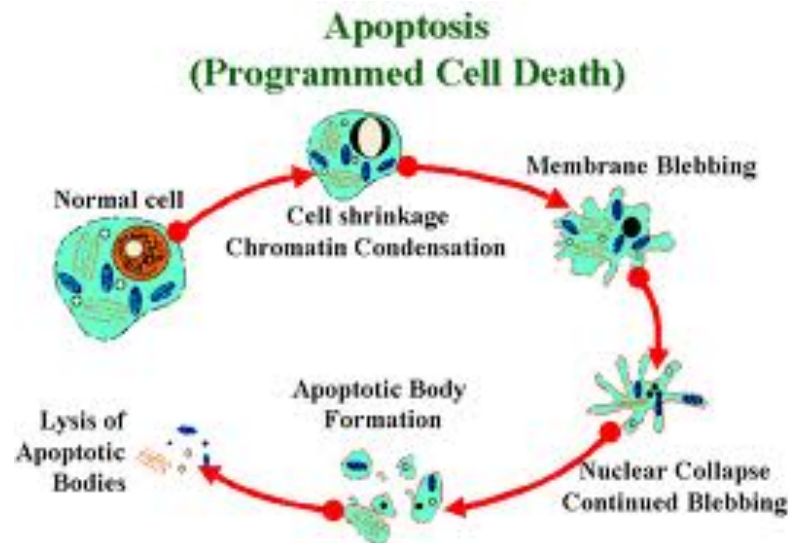
- Auxotrophs

- Strains of an organism that require an additional nutrient to survive
- Modified organisms are safer as they generally grow only in lab conditions
- Horizontal DNA transfer still possible



Knowns

- In eukaryotes, apoptosis can be readily triggered, causing cell death and DNA to be shredded
- Programmed cell death has been observed in some prokaryotes



Unknowns

- How well could we shred DNA in prokaryotes?
- Can we express DNAses and RNAses in a bacteria?
- Eukaryotes shred their DNA into ~180bp chunks in apoptosis: is this enough?
- Will implementation of this idea effect experiments in the lab?
- How to keep pathways, despite being evolutionarily selected against?