

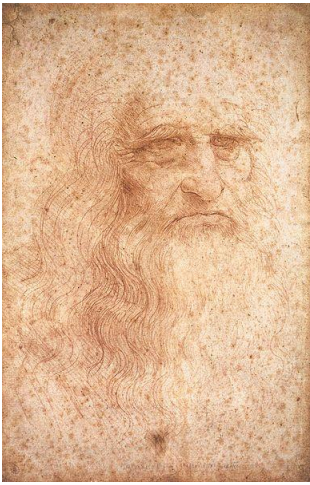
Our goal is to help you understand:

What is Engineering?

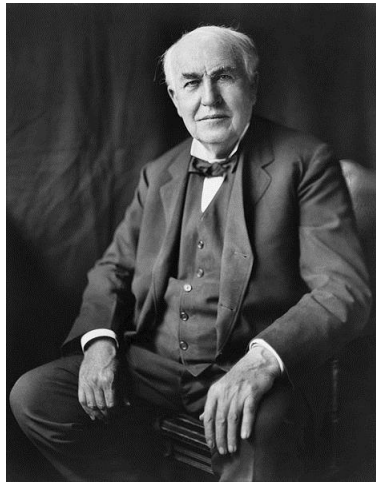
...and how is it different than science?

What do you think an engineer does?

Can you name any famous engineers?



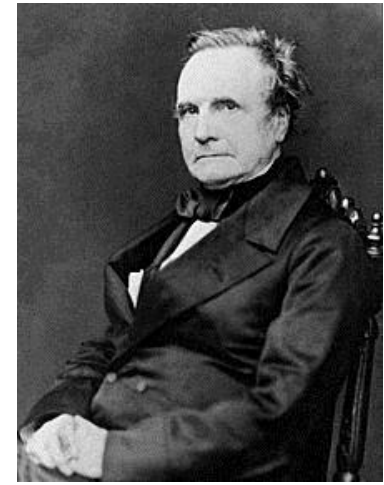
Leonardo Da Vinci



Thomas Edison



Pres. Herbert Hoover



Charles Babbage

Some famous engineers



Marissa Mayer
(CEO of Yahoo!)



Mae Jemison
(Astronaut)



J. Ernest Wilkins
(Manhattan Project)



Bill Nye
(The Science Guy)

Short Bio of Prof. Nik Nair

1999 – 2003 Cornell University (BS in ChBE)

Fall 2001 Merck (Intern in Manufacturing Support, Varivax[®])

Summ 2002 Merck (Intern in Process Validation)

2003 – 2004 Bristol-Myers Squibb (Protein Purification Scientist)

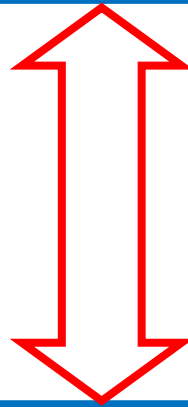
2004 – 2010 University of Illinois, Urbana/Champaign (PhD in ChBE)

2010 – 2013 Harvard Medical School (Post-doc in Microbiology)

2013 – present Tufts University (Assistant Professor of ChBE)

Systems Bioengineering & Synthetic Biology Lab

Understand microbial
physiology, adaptation
and evolution

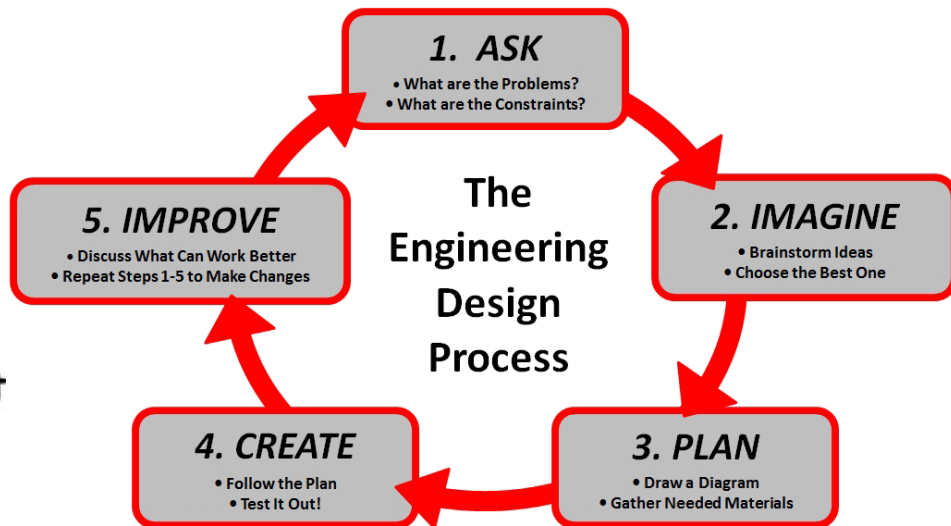
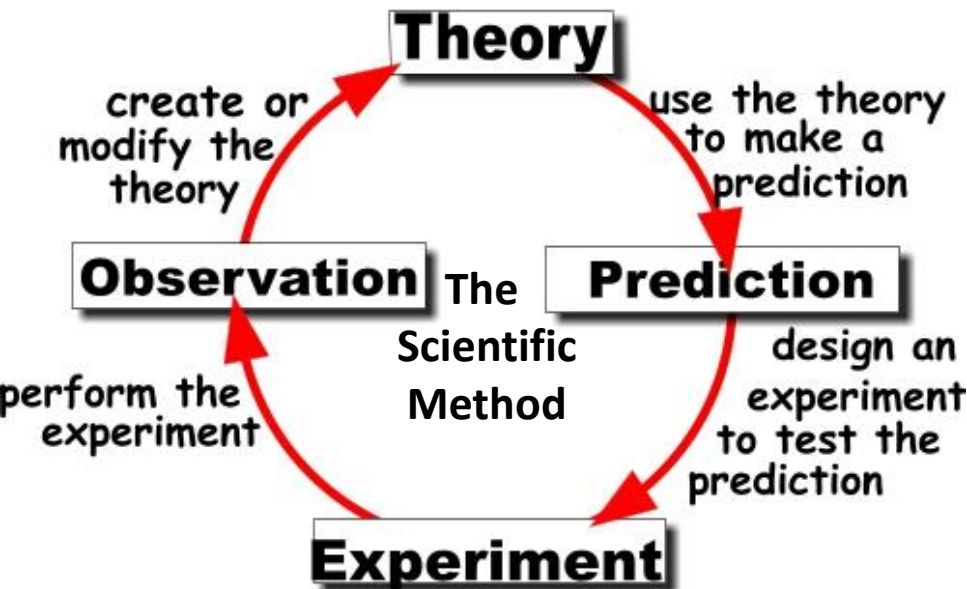


Engineer them for
biochemical & biomedical
applications

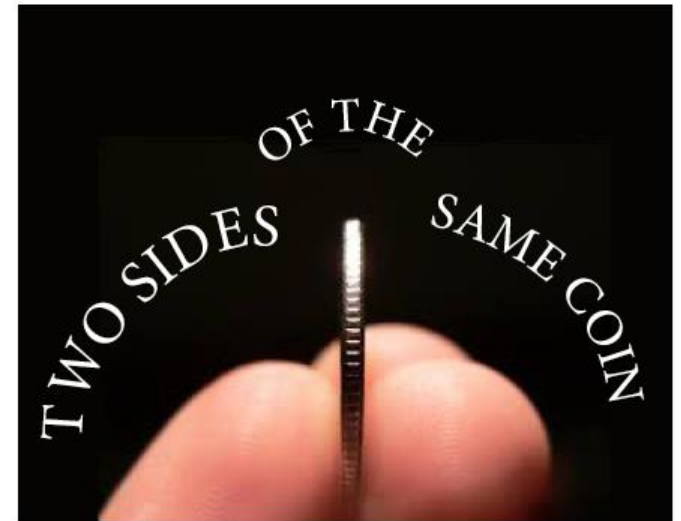
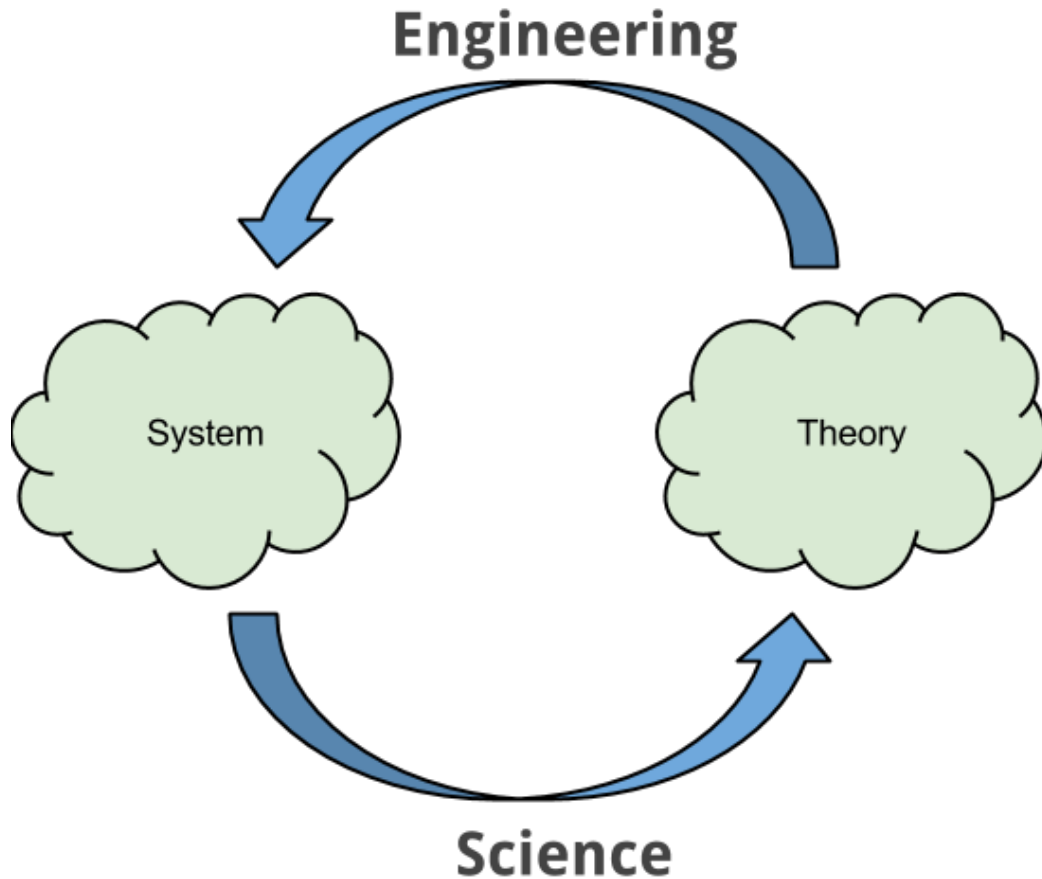
What is Engineering?

...and how is it different than science?

- Biology and Engineering
 - Hypothesis-driven
 - Design-driven
 - Discovery-driven
 - Invention-driven



What is Engineering? ...and how is it different than science?



What is Engineering?

- Not just about building cars, robots, and bridges
- Engineering is involved in any type of invention and optimization
- Synthetic biology is engineering with biology

What is Synthetic Biology?

- Designing and building/modifying organisms for specified needs

What is Synthetic Biology?

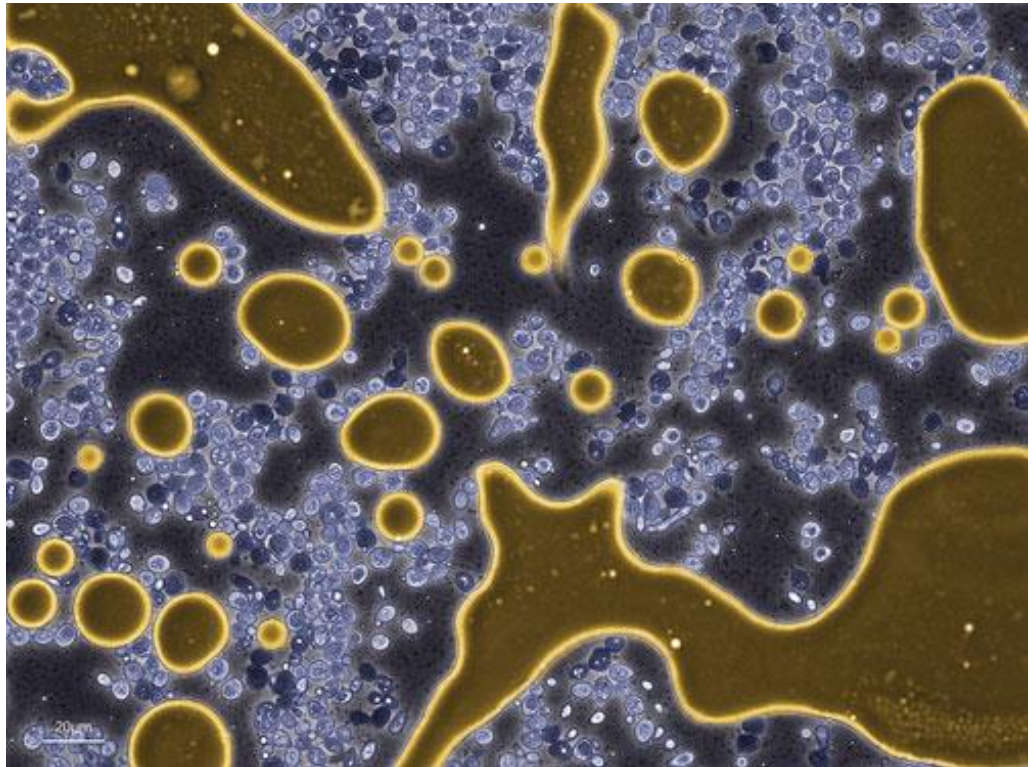
- Needs addressed in various fields
 - Biomedical
 - **Chemical**



Metabolomix

What is Synthetic Biology?

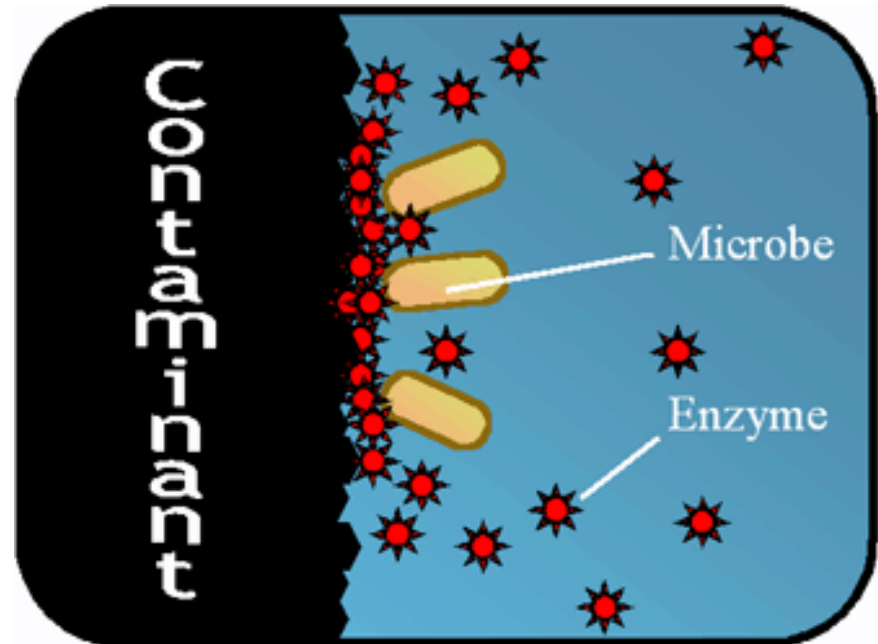
- Needs addressed in various fields
 - Biomedical
 - Chemical
 - **Energy**



Amyris

What is Synthetic Biology?

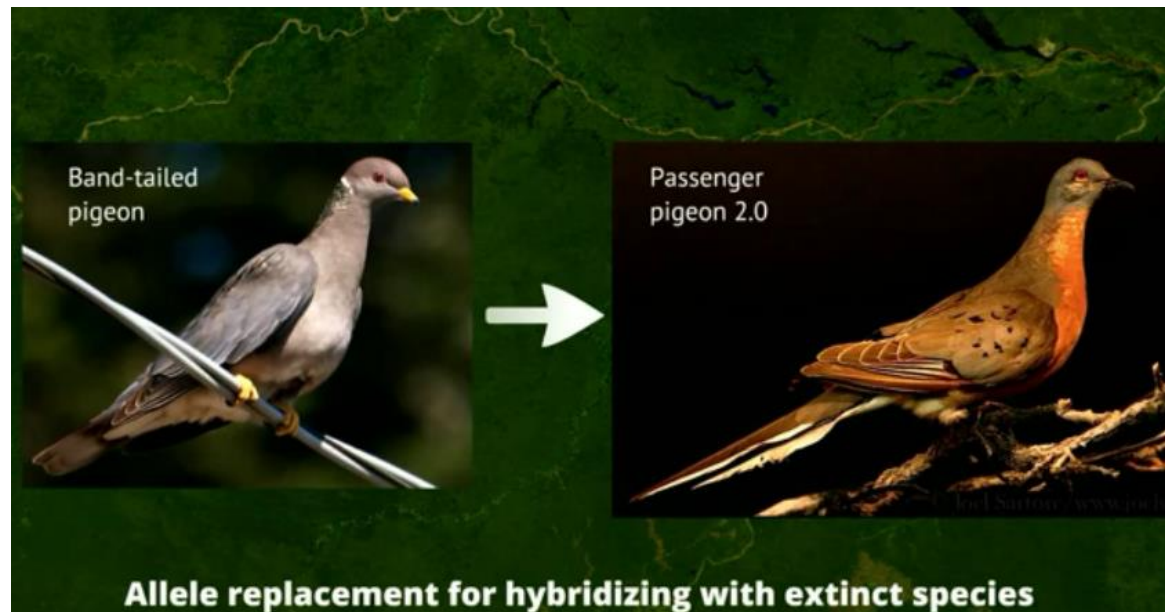
- Needs addressed in various fields
 - Biomedical
 - Chemical
 - Energy
 - Agricultural
 - **Environmental**



<http://www.integraenvironmental.com/Images/1contaminant.gif>

What is Synthetic Biology?

- Needs addressed in various fields
 - Biomedical
 - Chemical
 - Energy
 - Agricultural
 - Environmental
 - Scientific
 - **“Cool stuff”**
 - **“Jurassic Park”**



What is Synthetic Biology?

- Needs addressed in various fields
 - Biomedical
 - Chemical
 - Energy
 - Agricultural
 - Environmental
 - Scientific
 - **“Cool stuff”**
 - **Fluorescent pets**



BioGlow Avatar™



GloFish

The Experiment

Parts of a sensor



Input
(external stimulus)
(eg: movement)



Detector
(recognizes input,
creates signal)
(eg: motion detector)



Actuator
(takes input signal and
converts it to output)
(eg: switch)



Output
(detectable
signal)
(eg: light)

A motion sensor

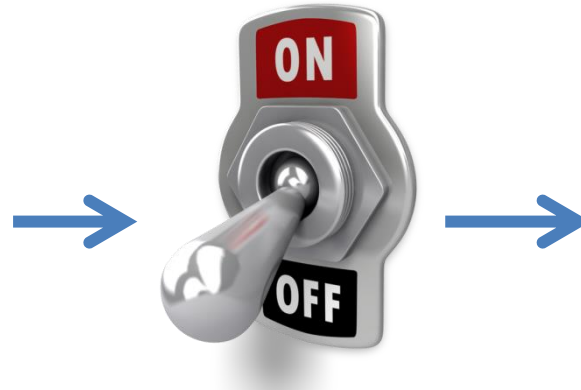
Biological sensor



Input
(external stimulus)
(eg: movement)



Detector
(recognizes input,
creates signal)
(eg: motion detector)



Actuator
(takes input signal and
converts it to output)
(eg: switch)



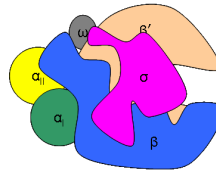
Output
(detectable signal)
(eg: light)



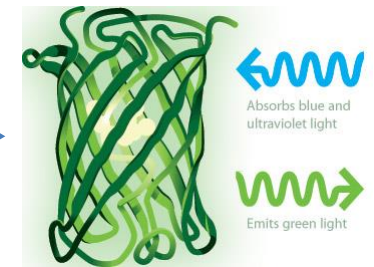
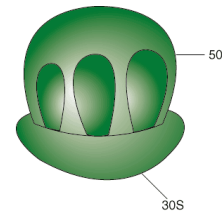
**Pathogen
metabolite**



**Binding
protein**



**Cellular protein
production machinery**



**Fluorescent
protein**

Forensic investigation of infection

- *Candida albicans* infects the intestines
- Causes a disease called Candidiasis
- Arabinose: metabolite (biological chemical) produced by *Candida* excreted in urine (not in uninfected people)
- Biosensor is responsive to arabinose

Where is “patient zero” from?

- Patients with symptoms of Candidiasis test for the diagnosed with the biosensor
- # of cases vary with town
- Seem to be clustered in certain towns near the Mystic River
- Remember: the disease likely travels downriver only

Find “ground zero”



Find “ground zero”



“Ground zero” is Somerville



Survey

- Participation in the survey is optional
- The purpose of the survey is to help us understand how effective we were at explaining the concepts of engineering
- The survey should take ~5 min
- The survey will not affect your grade in any way
- The survey will remain completely anonymous – please don't write your name or any other identifying information
- If you have any questions or concerns, please contact Mr. Cieri or Dr. Nair

More questions about engineering?

- Prof. Nair: nikhil.nair@tufts.edu
- Josef Bober: josef.bober@tufts.edu
- Venkatesh Gopi: venkatesheg@gmail.com
- Marilyn Allen: marilyn.allen@tufts.edu

- Can also Google “Nair lab Tufts” to find us.