03-757 Week 1
Synthetic Biology

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What is Synthetic Biology?

- Synthetic chemistry: synthetize chemicals not found in nature
- Synthetic biology: create new biological parts / systems that do not exist in nature
- National Academies of Science (2013): "combines both scientific [fill]"

What is the difference between synthetic biology, genetic engineering, metabolic engineering, biological engineering?

- Engineering approach to cell and molecular biology
- For studying cellular systems in addition to technology development
- Modular design

Parts, Modules, Computation

Think about biological parts as computers. Each biological part does something different, similar to how computers each compute something different. Each different part is a module, and you can put the modules together in different ways. Different Levels of biology, and their significance:

- Four biological macromolecules (proteins, lipids, carbohydrates, nucleic acids. Maybe we can add more?)
- Central Dogma (DNA to RNA to proteins... generally. Some viruses can duplicate RNA or go from RNA to DNA.)
- Genetic Codons (RNA to proteins. We can use a process called codon expansion to add new DNA bases and amino acids.)
- Organelles (Compartments where cells do different things.)
- Cells (Cells may be different in structure depending on their function. e.g., skin vs. neurons.)
- Cell Division (Mitosis. Can we make something that can duplicate itself? Are viruses life?)
- Biological Systems (Can reproduce, but can also evolve.)

Biocomputing

The fundamental question is, can you compute using biological parts?

Example biological circuit:

- Signals A and B are transcription factors for Gene 1 and Gene 2, which each code for a transcription factor.
- Gene 3 requires the products of both Gene 1 and Gene 2 in order to begin transcription.
- Therefore, if transcription factors A and B are present, then the product of Gene 3 is formed. This is an AND gate.