

Learning for Life Week 3 Summary

Topic: Synthetic Biology

Speakers: Milan Mrksich, Michael Jewett and Neda Bagheri

Today we learned about the fascinating new field of synthetic biology and how Northwestern, under the direction of Milan Mrksich has become a nationally recognized Center for Synthetic Biology that brings together faculty and students from across disciplines to develop new drugs, products and systems.

Milan explained how nature is very advanced--organisms can turn simple biomaterials into complex functions and products, largely through the use of enzymes which can be described as catalysts that produce reactions. The field of synthetic biology harnesses the ingenuity of nature by taking enzymes out of natural systems and putting them to use in novel ways and systems with the resulting ability to design new products or produce products and drugs faster than traditional methods have allowed.

The power of this technology was described with the example of artemisinin, an antimalarial drug whose source is a plant leaf. The synthetic biologists identified the enzymes that the plant used to create Artemisinin. They were able to put the relevant DNA into yeast cells that then produced artemisinin at a 10 fold faster rate than prior production methods. Obviously this has the potential to reduce cost and increase product delivery to countries fighting malaria.

Mike described the tug of war between using live cells as the bio-manufacturing home for the enzymatic reactions that can produce these novel products. The cell wants to do what it wants to do, but the engineers want the cell to act like a production system. That delays the process. One solution is to make "cell free" systems where the enzymes catalyze reactions in an environment not bound by the natural properties of the cell (like the yeast in the example above). We learned about the design of cell free systems that could make vaccines that could be "freeze dried" and delivered to parts of the world where they could be utilized.

We then learned about the very challenging field of computational biology and machine learning and how mathematical modeling and computer simulation can be applied to these biological systems.

Overall this was a fascinating introduction into a new field that is clearly going to have a tremendous impact on medicine, manufacturing and the environment in the very near future.

Take Home Points

- 1) Synthetic biology is an emerging field combining biology, engineering and computer science. Collaboration across disciplines is key to its success.
- 2) Synthetic biology is based on the premise that cells are factories that can be used to produce new compounds, vaccines and drugs
- 3) Reducing the time to develop new drugs and therapies is critical to preventing worldwide threats such as antibiotic resistance

