Engineering life: How synthetic biology is improving the world around us

Wednesday, September 30th 2015

Introduction

Biology is a new science. It was only about 200 years ago that Charles Darwin formulated the principles of Evolution by natural selection, and Gregor Mendel described the first clues that living organisms have Genes. These and other recent discoveries form the basic building blocks of our understanding of life. Synthetic Biology is a new field endeavoring to engineer life using modern technologies and modern understanding of Biology, with the goal of improving our world.

Our Lecture will begin with Dan Tarjan providing a historical perspective on Molecular Biology and Synthetic Biology. Then Justin Feng will explain Metabolic Engineering, from a recent success story to his own thesis work, at the intersection of Evolution and Engineering. Finally John Min will explore how Synthetic Biology offers the possibility of engineering Nature outside of the lab, and he will discuss the implications of that in the context of his own research.

Speakers

Dan Tarjan is a PhD student in the Biological and Biomedical Sciences program at Harvard Medical School working in the laboratory of Prof. Bradley Bernstein. His current research is focused on understanding how stem cells become all the different types of cells in your body. He enjoys traveling, photography, and great coffee.

Justin Feng is a PhD student in the Biological and Biomedical Sciences program at Harvard Medical School. He works in the laboratory of Prof. George Church, and his current research is focused on the development of technologies to sense and respond to small molecules in vivo. Previously, he worked at Amyris and in the lab of Prof. Jasper Rine at UC Berkeley. Outside of science he enjoys rock climbing, eating pizza, complaining about the weather, and dreaming about becoming a NatGeo photographer.

Jianghong "John" Min is a PhD student in the Biological and Biomedical Sciences program at Harvard Medical school, studying in the laboratory of Prof. George Church at the Wyss Institute. Currently his research is focused on developing a gene-drive system in the soil nematode C. elegans as a model system for future real world applications. Previously he worked in the laboratory of Prof. William Shih on DNA Origami and related nanotechnologies. In his free time he enjoys tinkering with electronic gadgets and graphic design.
**Glossary of Important Terms**

**DNA:** Deoxyribonucleic Acid. Composed of the four “bases” Thymine, Adenosine, Guanine, and Cytosine, this “double-helix” molecule encodes the blueprints for life in all organisms on earth.

**RNA:** Ribonucleic Acid. Very similar to DNA, each molecule of RNA is a copy of one gene from the DNA, and carries the information of that gene to other parts of a cell.

**Protein:** Proteins are made of amino acids, and each gene typically encodes how to assemble the amino acids to make one protein.

**Gene:** A discrete unit of inheritance. Genes are written within DNA, and typically encode one Protein.

**Genome:** The total sequence of all the DNA within a cell of an organism.

**Enzyme:** specifically, those proteins that change one molecule into another molecule.

**Chromosome:** A stable, inherited piece of the genome. Humans have 46 chromosomes, in 23 pairs. In each pair, one chromosome is inherited from your mother, and one from your father.

**Mutation:** a change in the DNA of an organism

**Wild Type:** a “regular” organism, with no mutations of interest.

**Homozygous:** having the same copy of a genetic trait on both chromosomes.

**Heterozygous:** having the different versions of a genetic trait on each chromosome.

**Selection:** “survival of the fittest,” the process by which some organisms with variation reproduce and others do not, leading to overall changes in the variation of a population of organisms.

**Gene-Drive:** a “selfish” gene system that exploits the rules of inheritance to spread itself through a population faster than Natural Selection would normally allow.

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