UNIVERSITY of WASHINGTON

Undergraduate Research Symposium May 17, 2013 Mary Gates Hall

Online Proceedings

Poster Session 1

Commons West, Easel 13

11:00 AM to 12:30 PM

Exploring the Genetic Basis of Thermostability in the RNA Virus phi-6

Kimber Clementine (Clementine) Dunnell, Senior, Biology (Ecology, Evolution & Conservation)
Emily Hsieh, Senior, Biochemistry, Biology (Molecular, Cellular & Developmental)
Levinson Emerging Scholar, Mary Gates Scholar, Undergraduate Research Conference Travel Awardee
Mentor: Benjamin Kerr, Biology
Mentor: Sonia Singhal, Biology

Thermostability is the capacity of an organism to survive and thrive at high temperatures and is a characteristic with many biotechnological applications, such as food processing. We are seeking to understand the mechanisms of thermostability in viruses by using an RNA virus, phi-6 Cystovirus. We are evolving the phi-6 virus to become thermostable by exposing it to a target temperature of 61C over many generations (wild type viruses grow at 25C). In order to see if exposure to different intermediate temperatures affects the genetic pathway to thermostability, we will expose the phi-6 virus to different temperature regimes prior to reaching the target temperature. The temperature treatments are sudden, where the virus is exposed to the target temperature throughout the entire course of the experiment, moderate, where the virus is exposed to the target temperature halfway through the experiment, and gradual, where the virus is exposed to the target temperature on the final day of the experiment. The genome of phi-6 has already been characterized, which enables us to compare the genome of the evolved, thermostable phi-6 viruses to the ancestor and allows us to study the genetic basis of thermostability. In future studies, we hope to use these thermostable viruses to learn about costs and benefits of maintaining thermostability.

Session 1R

Synthetic Biology and Molecular Biotechnology

Session Moderator: Daniel Ratner, Bioengineering

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1:15 PM to 2:45 PM

* Note: Titles in order of presentation.

Social Dynamics of a Synthetic Cooperative *E. coli* System

Melissa Delaine (Melissa) Arnold, Senior, Biology (General)
Mentor: Benjamin Kerr, Biology
Mentor: Sonia Singhal, Biology

In this project, we explore conditions that are critical for *de novo* evolution of cooperation and altruism in a bacterial system. Previous theoretical work has shown that there is a competitive advantage to defection and selfishness, but the ubiquity of cooperation in nature suggests that cooperation may be adaptive. Here, we aim to uncover environments and genetic conditions that actually promote greater cooperation. We use an engineered cooperative strain of *Escherichia coli*. Through a bistable genetic switch, single cells have the capability to be either a producer cell that makes the cellulase enzyme to break down cellulose, or a consumer cell that eats the byproducts of cellulose breakdown. Our first aim is to characterize the social dynamics of this synthetic system and determine if a social dilemma is in fact occurring—i.e., is there a cost to producing cellulase, and can cheaters that do not produce cellulase displace the cooperators that do? Our second aim is to evolve the system over many generations and analyze how it changes. Uncovering the conditions favoring higher cooperation (e.g., greater production of cellulase) provides insight into how cooperation can evolve and how populations circumvent social dilemmas. We hope to use evolution as a tool to tune the synthetic genetic circuit for maximal cellulose breakdown. On a broader scale, these conditions that favor cooperation may have practical applications in waste degradation and biofuel production.