Seminars in Biotechnology BTEC 591 & BTEC 691

"Developing a CRISPR-cas9 system for honey bees to be used as a model organism for neurobiology research"

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13:30
MBG Conference Hall

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Christopher (Chris) Mayack is a faculty member in the Molecular Biology, Genetics, and Bioengineering program at Sabancı University. He first learned about honey bees when conducting a summer undergraduate research internship that focused on understanding the cognition and navigation abilities of foraging honey bees at the University of Kansas in 2005. During this time, he worked with Dr. Rudolf Jander, a former graduate student of Karl von Frisch (Nobel Laureate). He graduated with honors in biology and a minor in chemistry from State University of New York at Geneseo in 2007 and then earned a Ph.D. in Zoology at Colorado State University in 2012. During his Ph.D. he studied the physiological and behavioral effects of the now world-wide distributed honey bee microsporidian gut pathogen that is implicated to play a role in the most recent bee declines, called Nosema ceranae. He was then awarded a two-year Alexander von Humboldt Post-Doctoral Fellowship, which was conducted in Germany, at Martin Luther University Halle-Wittenberg, to pursue studies investigating the role highly conserved metabolic pathways in the evolution of social behavior in bees. As a two-year Visiting Assistant Professor at Swarthmore College, he has mentored a number of undergraduate research students interested in the dynamics of collective decision making, improving bee health, and the regulation of appetite in highly social bees. Currently, he would now like to take a multi-omic systems biology approach to understand how stressed bee colonies collapse. In particular, he is interested in the metabolic pathways that are affected from multiple stressors which lead to synergistic declines in bee health. In addition, he is developing CRISPR-cas9 tools to conduct knockdowns in the bee brain to understand the role of synaptic pruning in learning and memory as the bee ages, as well as appetite regulatory mechanisms and how they vary with the level of social behavior across bee species.

Abstract

Honey bees can be used and have been considered as a model organism for behavior, physiology, and neurobiology. This is especially the case when it comes to studying the evolution of social behavior. However, due to their social lifestyle, operating as a superorganism, advances in molecular tools and using genetic lines have generally lagged behind the closely related fruit fly model organism, Drosophila. In this talk I will discuss the challenges in using the honey bee as a model organism to study social behavior on a neuronal mechanistic level and how advances in CRISPR-cas9 offer new ways to overcome these challenges. I will give a number of ways of how in our lab we are going about developing the CRISPR-cas9 system, specifically for use in honey bee adults and neurological studies. I will then give examples from a number of fields of how CRISPR-cas9 may revolutionize utilizing the honey bee as a model organism, which promises to be a primary candidate for better understanding both neural mechanisms and the evolution of social behavior.