

Session D – Biology (Alphabetical)

Elucidating the Regulation of Dna2 Helicase/Nuclease Activity

Lu Chen

Mentor: *Judith Campbell*

Dna2 is a conserved protein from yeast to humans and is involved in genomic stability. Dna2 is well characterized and is known to possess both 5' and 3' exo/endonuclease activities as well as ATP-dependent 5'-3' helicase activity. There is considerable evidence that *in vivo*, Dna2 does not act alone, but acts in a network with other proteins that modulate its activity. The goal of my study is to characterize how these proteins regulate Dna2 activity. In particular, I am interested in those proteins that may act as a molecular switch in DNA replication and repair. One such protein is Replication Protein A (RPA), which has been found to stimulate 5' and inhibit 3' Dna2 nuclease activity on G quadruplex substrates. My aim is to further elucidate the mechanism of the Dna2-RPA interaction through nuclease and binding assays on various DNA substrates known to arise during replication or repair.

Preliminary Work on a High Resolution Electron Cryo-Tomographic Survey of Seven Phylogenetically Diverse, Thin Microbes

Wesley Chen

Mentor: *Grant Jensen*

Electron cryo-tomography (ECT) is a powerful new tool that is capable of producing three-dimensional reconstructions of microorganisms and proteins in their near-native state in close to atomic resolution. This approach can be used to visualize various ultrastructures within bacterial cells, such as storage granules, cell wall composition, chemotaxis arrays, and cytoskeletal filaments. Due to limitations with electron back-scattering, only moderately thin samples can be imaged and analyzed. In this comparative study, we survey seven phylogenetically diverse thin bacteria archaea with ECT and discuss the differences and similarities in ultrastructures among these prokaryotes.

Comparison of the Quantization of GluRIIA Levels in Hyperexcitability Mutants Before and After Activity Induction to Results in Pumilio Mutants

Lily Li

Mentor: *Kai Zinn*

Learning and forming memories are made possible by regulation of synaptic plasticity, which can be studied by using the *Drosophila* larval neuromuscular junction (NMJ) because it shares many functional similarities with the mammalian synapse. An increase in larval motility necessitates a rapid increase in synaptic strength and thus local translation at the larvae NMJ is a mechanism that makes this possible. In both hyperexcitability mutants and Pumilio (Pum) mutants, there is a recorded increase in eIF-4E aggregates, which increases GluRIIA expression and thus synapse strength. The Pum mutants show high GluRIIA levels before and after activity induction, indicating that Pum is necessary for the repression of eIF-4E accumulation at the NMJ in less motile larvae and for subsequent decreases in synaptic plasticity (Menon 2004). However, it remains unknown if like the Pum mutants, the hyperexcitability mutants also show the same high GluRIIA levels before and after activity induction. Here we want to see if Pum and mutants with increased neural activity like *eag*^{Δ932} and NaChBac1-EGF act in similar ways to regulate/control synaptic plasticity as well as to assess what effect decreased neural activity mutants have on GluRIIA expression. We generated increased and decreased neural activity mutants, dissected the larvae, and quantified the number of boutons at the NMJs and the levels of GluRIIA expression for the larvae before and after activity induction. These results were then compared with those from the Pum mutants.

A Comprehensive Survey of Thin Bacteria By Electron Cryo-Tomography to Discover Novel Ultrastructures at High Resolution

Bonnie Zhang

Mentors: *Grant Jensen and Morgan Beeby*

Electron cryo-tomography provides high resolution images of biological specimens in near-native state. This method overcomes the limitations of traditional electron microscopy through the use of vitreous ice to preserve native structures instead of chemical fixation and subsequent staining. A series of images are collected over various angles and used to extrapolate back to a 3-D model of the sample. The novelty of electron cryo-tomography, along with recent successes of discovering new, previously unknown, cellular structures of the cytoskeleton, prompts us to initiate a comprehensive survey over many diverse bacteria. In order to prevent crystalline ice from forming and to attain images with high resolution, it is important to collect data from thin bacteria that are smaller than 500 nm in width as sample thickness reduces resolution. I have compiled a comprehensive list of bacteria that are sufficiently thin and have grown a

select number of them. By imaging the specimen with a cryo-electron microscope and reconstructing the tomograms, I have seen various ultrastructures, such as granules and possible filaments, and have added to the database of previously imaged bacteria. A preliminary intriguing observation, corroborating previous unpublished results from the Jensen lab, indicates a double-layer of peptidoglycan in select Gram-negative bacteria.