FACULTY: Erik Ullian

Question:

Two observations in studies of synaptic competition at synapses innervated by two axons at the NMJ are: 1) if action potentials and presumably presynaptic release is impaired at one axon, the impaired axon will "lose" and retract from the muscle synapse; leading to the idea that there is an activity dependent synaptic competition that drives competition. And 2) if an axon innervates multiple muscles and is competing at one of those synapses with an axon that only innervates that single muscle, the axon with only one synapse will always "win"; leading to the idea that there may be limited resources that determine the outcome of competition. Do these two observations suggest different mechanisms driving competition or could they be the same? With any tools and methods you can think of, how would you test this?

FACULTY: Sam Pleasure

Question:

A patient comes to see you in the clinic with seizures and mental retardation. You perform an MRI and see that the patient has a very small brain that is otherwise well formed. You discover that the patient is homozygous for a recessive mutation in the ASPM gene.

a. Explain why a gene that is involved in spindle function during mitosis would lead to a small but generally normally formed brain.

You develop a mouse mutant that models the patient's mutation and find that the mouse has a small but well formed brain. You perform detailed analysis of layer fate markers and you find that all cell types are represented, just in smaller numbers and that the proportional thickness of the various layers is intact.

b. What method could you use to determine how many neurons each individual neural progenitor produces during embryonic development? Do you expect this number to be normal?

Faculty: Anna Molofsky

Question:

Let's assume that astrocytes develop on a segmental template as a result of patterning and you can ablate and replace astrocytes from different domains at will at a very early stage of embryonic development. So, you transplant astrocytes from a dorsal domain of spinal cord to replace those ventral regions surrounding motor neurons. You find that resulting animals are viable but with behavioral testing they demonstrate defects in nociceptor responses and fail to withdraw normally from pain.

What might you conclude about the role of specific subtypes astrocytes in establishment or maintenance of the neural circuit? What are the types of tests and analysis you would propose to understand the basis of neural circuit defects, focusing on the pathway steps between the DRG—> MN?