Peter Hollenbeck 1

**Historical perspectives and current questions on axonal transport mechanisms & regulation**

The axonal transport of organelles has historically served as both a simple system in which the motors and tracks for movement were elucidated, and also a complex system in which the roles of signaling, physiology and development in controlling traffic have been studied. I will review the elucidation of the basic components of the force-generating system for axonal organelle transport and then lay out the basis for several important elements that remain to be fully understood: (1) how are anterograde and retrograde populations of organelles marked or distinguished? (2) how are stationary and motile populations of organelles related to one another? (3) how is axonal organelle traffic related to synthesis, biogenesis and turnover? (4) how is cell signaling marshaled to control organelle traffic in an immense and non-uniform cell? We have some general ideas about all of these, and progress continues to be made, but the important mechanistic details are proving to be elusive.

**Suggested readings:**

Grafstein B, Forman DS (1980) Intracellular transport in neurons. *Physiol Rev* 60:1167-1283. (For reference only, this is the last grand comprehensive review of the field, written before the motor proteins were identified)

Sheetz MP, Steuer ER, Schroer TA (1989) The mechanism and regulation of fast axonal transport. *TINS* 12:474-478.

Cyr JL, Brady ST (1992) Molecular motors in axonal transport: cellular and molecular biology of kinesin. *Mol Neurobiol* 6:137-155.

Saxton WM, Hollenbeck, PJ (2012) The axonal transport of mitochondria*. J Cell Sci* 125:2095-2105.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_