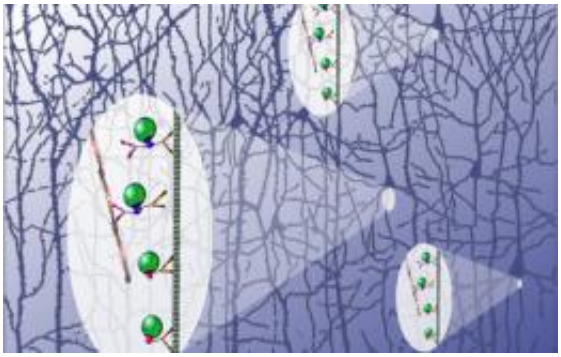
Motors on a mission

March 25 2011, byLaurie Moore



Inside each neuron, microtubules carry dendritic and axonal proteins to the dendrite and the axon with the help of motors Myosin Va and Myosin VI. Illustration by Su Hyun Kwon.

(PhysOrg.com) -- In a new study, Don Arnold and collaborators show that a microscopic motor drives axonal proteins to the right location in a neuron.

Within each of our bodies are billions of neurons. These cells relay chemical and electrical signals, forming vast networks that comprise the human nervous system.

Within each neuron is a microscopic network of its own, a complex system of signal transmissions. Proteins receive signals at the cell's dendrite and transmit them at the axon at the other end, passing the impulses from one neuron to another and allowing human beings to think, perceive and move.

“Dendrites and axons look different and have different functions so it makes sense that these two areas would be comprised of different proteins,” said Don Arnold, associate professor of biological sciences in the College. “My lab studies how proteins made in the cell body get transported specifically to dendrites or axons.”

Proteins are synthesized within the neuron and carried in a bubble called a vesicle down highways of microtubules that point to the dendrite and the axon. Neither the two proteins themselves nor the microtubules know where the proteins should end up, so a mix of dendritic and axonal proteins will go both ways, to the dendrite and to the axon.
Arnold admitted that the system is counterintuitive, if not downright complicated. “You’d think the proteins would be put on the right microtubules to start with.”
But the proteins are not always put on the correct path. Some proteins will end up in the right place, while others must be redirected.

A 2009 study by Arnold and his collaborators published online in *Nature Neuroscience* solved one half of what happens if proteins end up in the wrong place. If the proteins first encounter a microtubule heading toward the axon, both types will be carried toward the axon. However, the team discovered that a motor protein called Myosin Va acts as a filter in the axon. Myosin Va binds to the dendritic proteins, carries them out of the axon and allows the axonal proteins to continue.

The second paper, published on March 1 in *PLoS Biology* and authored by graduate student Tommy Lewis Jr. of the College, Tianyi Mao of the Howard Hughes Medical Institute, and Arnold, explores how the axonal proteins end up in the axon.

“Axonal proteins have a more complicated way of targeting to the axon,” Arnold said. “There are two ways of getting to an axon. The proteins either go directly to the axon or, more bizarrely, they go to the dendrites

where they're put on the surface of the cell."

Arnold and his team discovered that a related motor protein, Myosin VI, retrieves wayward axonal proteins from the dendrite, plucking the axonal proteins off the cellular membrane and carrying them to the axon. Myosin VI, they found, also plays a role in helping the axonal proteins find the axon in the first place.
"This whole process can be explained by the interaction with Myosin VI. It does both things," Arnold said.

Understanding this microscopic series of events will allow for more effective targeting of axons or dendrites, enabling finer control over neurons for basic research and possibly the clinical treatment of neurological disorders.

"It's extremely useful to be able to send something to an axon or a dendrite in an efficient manner," Arnold said. "What I like about this is that it's a simple system where you can do experiments that give you a definite answer. It's a way of moving forward."

Provided by University of Southern California