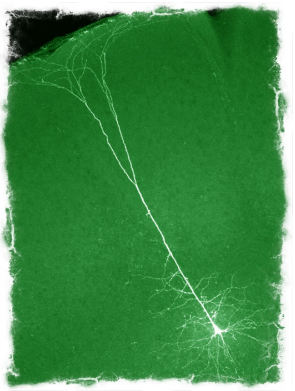
Neuroscience

Aging & Brain Function



Real-Time Imaging of Neurons

The brain is a dynamic and busy place, with the connections between neurons in a constant state of flux. Because of the plastic nature of these connections, studying them can present special challenges. The lab of **Ricardo Mostany** uses real-time *in vivo* imaging of neurons in rodent models to understand the impact of aging and neurodegenerative diseases like Alzheimer's on these connections. The lab studies this using specialized microscopes that can image deep into living brain tissue without causing damage. Additionally, they are developing systems that will allow the examination of neuronal pathways in active mice, observing the effects of different learning experiences on neuronal plasticity and development.

Neuronal Plasticity: Impact of Aging and Disease

Cognitive ability declines with age and during neurodegenerative diseases like Alzheimer's. While it is known that changes in how neurons behave are responsible for this decline in brain performance, the exact nature of these causative changes is up for debate. While it was thought that loss of neurons was the cause, this has proven not to be the case. The Mostany lab is focusing on the role of the synapses between neurons in aging and neurodegenerative diseases.

The synapse is the space between two neurons across which information is shared. This shared information comes in the form of discreet membrane-bound packages of signaling molecules sent from one cell to another. These synapses have varying degrees of stability (*i.e.* some last longer than others), and the number of individual connections between any two neurons can also vary. Using advanced custom-built two-photon microscopes that can image deep into living tissue without damaging it, the lab has discovered that as the mice age, the synapses become less stable, with connections being formed and lost again at a more rapid rate than when the mice were younger. This is also observed in mouse models of Alzheimer's disease, with more advanced cases having greater synapse turnover.

Neuronal Plasticity: Impact of Aging and Disease

This concept of synapse turnover is also important in learning. When mice learn something, there is a temporary increase in neuron plasticity and synapse turnover. However, this is only observed in young mice – neurons in older mice do not undergo this rise in turnover. Indeed, there is a decrease in these mice. The lab hopes that these insights into synaptic turnover during aging, neurodegenerative disease, and learning will lead to better treatment options for diseases and enhance our ability to arrest or delay cognitive decline with aging.

Developing Technologies and Collaborations to Advance Neuronal Imaging and Mapping

Thanks to their specialized expertise in imaging the living nervous tissue in mice, the lab has many ongoing collaborations with researchers across the Tulane campus. These include collaborations with the school of science and engineering to design and implement a wearable optogenetic stimulator that will allow neuronal activity to be controlled while the mouse is free and mobile.

Additionally, they are applying their imaging expertise to the real-time observation of the growth and metastasis of glioblastoma multiforme tumor cells in the brain. The lab also has collaborations with the Tulane Center for Stem Cell Research and Regenerative Medicine. These partnerships add broad scientific context to the lab's own research, making them a valuable asset both to Tulane and any potential future collaborator.

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