Cellular and molecular mechanisms of glial morphogenesis

The MacDonald lab aims to understand how a healthy eye is built and maintained throughout life. The retina is the light sensitive part of the eye that allows you to see. Glial cells are the major support cell in the nervous system but are poorly understood if compared to neurons. They are intricately shaped to contact and support neuronal synapses. We are currently interested in determining the cellular and molecular mechanisms regulating glial morphogenesis in the developing retina, with a particular focus on the consequences of disrupted glial contacts on neuronal function and vision.

We use the zebrafish retina as a model as it contains the same neuron types and glial cells as the human eye. The principal glial cell type in the retina is the Müller glial cell. These glial cells have elaborate morphologies to span the retina and support each neuronal layer. The zebrafish embryo is an incredible system to study development – it is transparent, we can label each cell with specific fluorescent markers and use time-lapse confocal microscopy to watch eye development happen in real time in a living fish. Further, we have molecular markers specific for each neuronal and glial cell type and a complete transcriptomic dataset with potential candidates involved in glial morphogenesis.

Below are some projects we are currently working on but they can be modified according to the interests of the student. Available projects include the following, which will typically involve in vivo confocal or super-resolution microscopy, immunohistochemistry, CRISPR/Cas9 mutagenesis and molecular biology.

1. Super-resolution characterisation of glial morphology and synaptic contacts
2. Uncovering the role of cell adhesion molecules in glial morphogenesis
3. Glial-neuronal interactions during synaptic circuit assembly
4. The role of neuronal activity on glial morphogenesis and connectivity

Relevant Publications:
