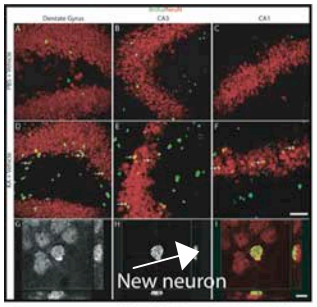
PhD Studies in Neurodegeneration and Stem Cell Research

Dr Bryce Vissel
Garvan Institute of Medical Research
Phone 02-9295 8293, Email b.vissel@garvan.org.au

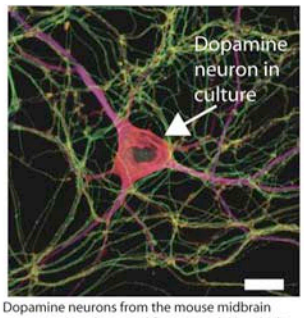
PhD Studies in our group will allow you the opportunity to learn and develop cutting edge technologies and approaches that will contribute to a deeper understanding and treatment of Parkinson's disease, Alzheimer's disease and spinal cord disorders. You will help understand and develop treatments for these terrible disorders. You will receive a lot of support and you will emerge from your studies as a well-trained scientist, knowing how to think about and how to address important scientific questions. If you are interested in making an impact, please email and visit us. These are kinds of studies you could undertake:

1. Neural Regeneration Research and Studies of Stem Cells: Students have the opportunity to study neural regeneration by undertaking a PhD in our lab. The student will develop a specific topic of research under the supervision of Dr Vissel, while learning advanced techniques in the study of neurogenesis from post-doctoral researcher, Andrea Abdipranoto. Adult neurogenesis is the generation of new nerve cells in the adult central nervous system (CNS). Stimulating neurogenesis may potentially offer a therapeutic approach for neurodegenerative diseases such as Parkinson's disease, Alzheimer's disease, and motor neuron disease. In our group, we are working to identify mechanisms that regulate adult neurogenesis (neural repair mechanisms) in the normal and diseased brain, and determine if manipulating these mechanisms may offer therapeutic potential. Techniques learned will include:
(1) Stereotaxic survival surgery and gene therapy approaches, (2) Immunohistochemistry combined with advanced confocal microscopy and stereology for analysis of regeneration. (3) Use of *in vitro* cell systems, including neural stem cells, for studying neurogenesis. (4) Behavioural testing to determine the capacity for functional recovery in animal models (5) molecular biology.

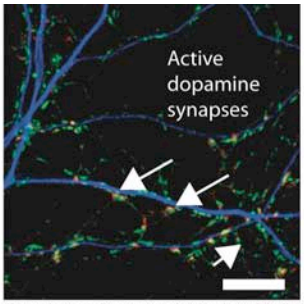
2. Neurodegeneration Research and Studies of Synapses: When neurons in the midbrain that secrete DA die, this results in profound loss of motor function and eventually death. This nerve cell loss leads to Parkinson's disease. The biology of DA neurons is poorly understood, in particular the mechanisms that regulate the function of synapses formed by these neurons. We are researching these synapses to develop a greater understanding of the role that DA synaptic function might play in the aetiology and pathology of Parkinson's disease. Students have the opportunity to study synaptic function in DA neurons in our lab. The student will develop a specific research topic under the supervision of Dr Vissel, while learning advanced techniques in studying DA synaptic function from post-doctoral researcher, James Daniel, including: (1) Culture of primary cells from mouse neural tissue, including glial cells, DA neurons and hippocampal neurons (2) Immunocytochemistry combined with advanced confocal microscopy (3) Advanced methods in microscopy for analysing active synapses formed by live neurons (4) New concepts and world-leading techniques and technologies.



We use mouse models of brain and spinal cord injury to study the mechanisms that regulate the birth of new neurons in the brain. Shown here are sections of mouse hippocampus from mice that have either undergone no treatment (PBS + vehicle) or a lesion (KA + vehicle). Red cells are neurons, and yellow cells are new neurons that have been created after treatment, i.e. neurogenesis.



Dopamine neurons from the mouse midbrain are grown in culture, and form a model in which dopamine neurons can be studied using advanced techniques in live cell imaging and immunocytochemistry. Shown here is a dopamine neuron that has been fluorescently labelled. The cell body and dendrites (magenta) and axons (green/yellow) are shown.



Shown here is a live neuron that has been labelled with FM 1-43, with each green 'spot' representing an active synapse. After labelling, we use immunocytochemistry to identify which of the green synapses are formed by DA neurons. Shown in yellow are DA synapses onto dendrites of a target neuron (blue). We are currently the only lab in the world using this technique to study active dopamine synapses.