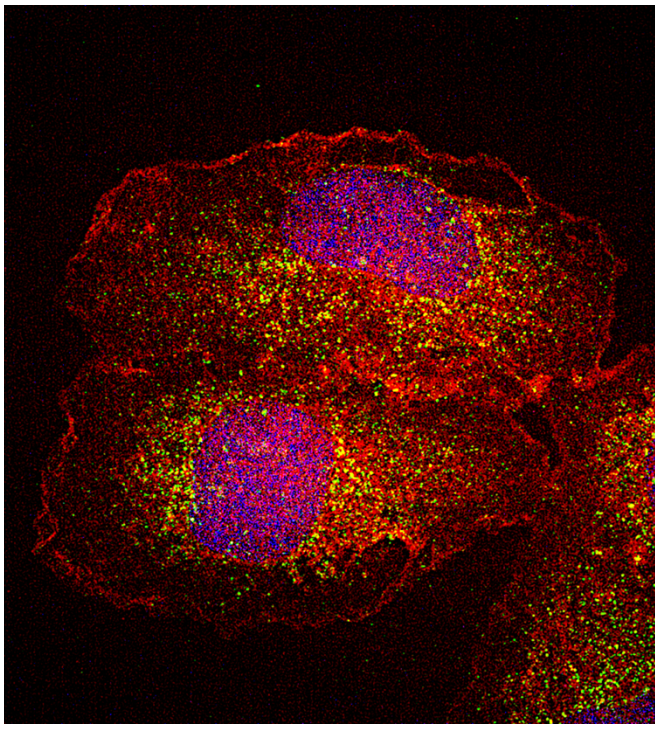
Mast Cell Degranulation in Response to Rho Activating Drugs



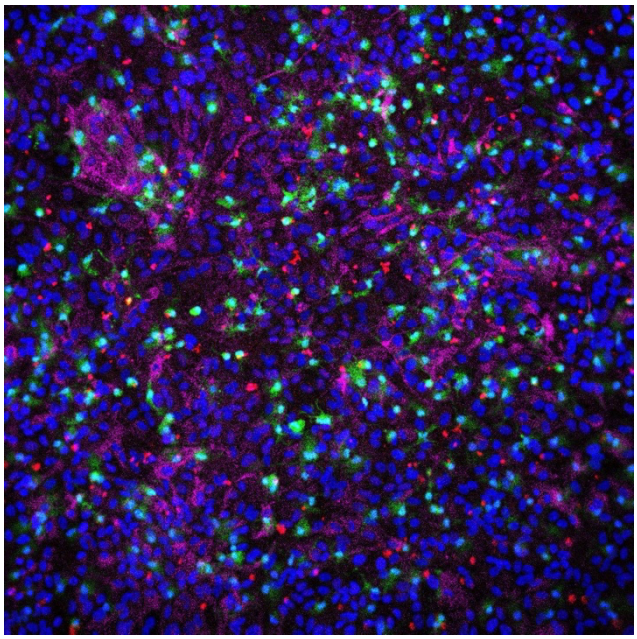
Created by: Juliette Eshleman
with Eric Zhang, supervised by Gary Eitzen

Mast cells are tissue-resident immune cells that contain high-levels of preformed pro-inflammatory mediators such as histamine, heparin and enzymes that typically play a protective role in fighting infection. However, dysregulation in the release of these mediators plays a major role in the pathogenesis of allergic disorders such as asthma and anaphylaxis. Rat Basophilic Leukemia (RBL-2H3) cells were used as a mast cell model. Through IgE-mediated FcεRI signalling, they recapitulate a strong degranulation response when stimulated by 50 µM calpeptin, an indirect RhoA GTPase activator. Immunofluorescence microscopy is performed on Rho activated RBL-2H3 cells to assess morphological changes to the actin cytoskeleton and granule-marker distribution. Immunofluorescence images were aquired on a Zeiss Elyra 7 super-resolution microscope. A granule marker, CD63, is stained using mouse polyclonal antibodies (green). G-actin is stained with phalloidin (red) and the nuclei are stained with DAPI (blue). Actin cytoskeletal morphology in calpeptin-treated stimulated conditions appear similar DMSO-treated control cells in the presence of indirect Rho activating drugs.

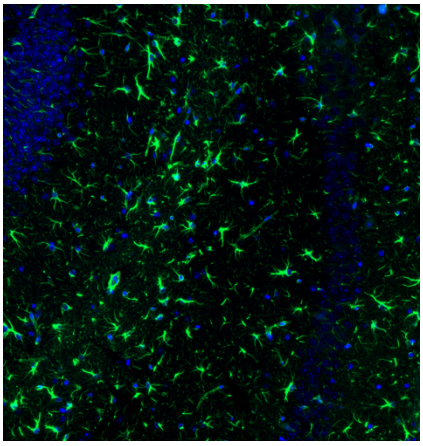
Galaxies of Glia Interface with Technology

This image shows cultured primary glial cells imaged with a confocal fluorescent microscope. Glial cells are the cells in the nervous system which are not neurons. One responsibility of the glial cells is to keep the nervous system environment safe from foreign pathogens. Two types of glial cells important for immune function are the microglia, shown in green, and the astrocytes, shown in magenta. The nuclei of all cells are shown in blue and interleukin-1β, the inflammatory cellular signalling molecule, is shown in red. My research investigates the interaction between these cells and an electrode implanted into the central nervous system. Microglia recognize that the presence of an implanted electrode and the emission of electricity is abnormal. In response to chronic implantation of an electrode, the microglia form a layer to isolate it from the rest of the nervous system. Next, they recruit the astrocytes to the electrode, which forms another layer separating the electrode from the nervous system. Intercellular signalling with interleukin-1β is implicated in the formation of this scar. Fluorescent images such as these provide data on how different patterns of electrical stimulation affect cell morphology, inflammatory signalling, and death of cells at the surface of electrodes. This data is useful for the engineering of devices that are more biocompatible with the central nervous system, allowing for prolonged implantation without the formation of the glial scar by microglia and astrocytes.

Created by: Matthew Birtle
with Christopher Kui, supervised by Kathryn Todd



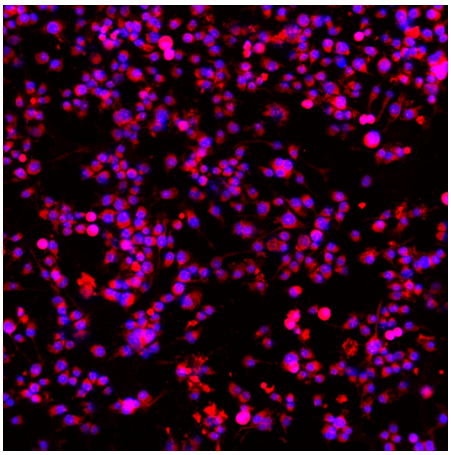
Astrocytes: the stars of the brain



Immunostaining for glial fibrillary acidic protein reveals astrocytes in the hippocampus of an adult mouse brain. When people think of neuroscience, neurons are often the cells that come to mind. However, astrocytes are increasingly recognized as key players in neural function by regulating neurotransmission and the blood-brain barrier. This image was taken as part of a project investigating how a loss of bone morphogenetic protein 7 from the meninges leads to hydrocephalus. We are investigating how the glymphatics system is affected in this mouse model, and astrocytes are a key component of this system. The astrocyte projections (green) give these star-shaped cells their name. DAPI (blue) marks cell nuclei. Image was captured using a Zeiss Axioimager microscope and analyzed with ZenLite.

Created by: Katherine Souter
with Daniela Roth, supervised by Daniel Graf

Morphological changes in microglia upon sensing the environment



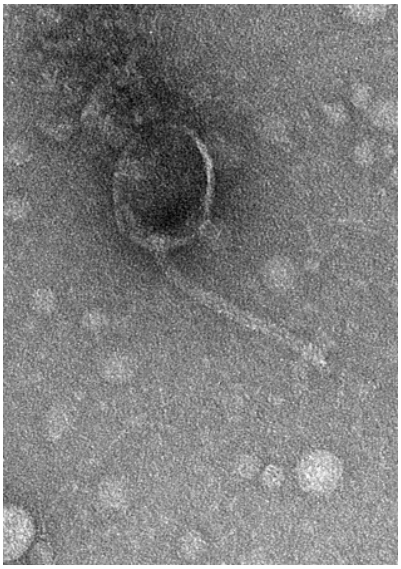
This laser microscopy image depicts microglial cell line, immune cells residing in the brain that respond to injury, support homeostasis, and aid in development. The cells contain nucleus (blue) and branched protrusions (red), which extend to survey the surroundings. If microglia sense a pathology, they adopt a round shape (bright red-purple cells) and release pro-inflammatory cytokines, triggering neighboring cell to undergo the same change and proliferate. While such dichotomy between morphological states of microglia does not exist in vivo, this change highlights the diversity of function and flexibility of microglial expression. In my research project, I test how certain anti-inflammatory compounds influence inflammation in microglia. To me, microglia exemplify the intricacy of environmental sensing which ultimately permits for existence of life.

Created by: Kira Sviderskaia
supervised by Christopher Tsui and Matthew Churchward

The Solar Farming Revolution: Agrivoltaics is Changing the Game

This captivating image captures the remarkable growth of spinach crops flourishing beneath a 100-watt solar panel, capable of providing energy to power various devices, such as laptops and computers. This image is just one facet of my research on agrivoltaics, a revolutionary system that fuses crop production and solar energy generation on the same land. As the world population continues to escalate, it is becoming increasingly urgent to ensure sustainable food and energy production. Agrivoltaics offers a wealth of benefits, including water-use efficiency, dual land use, reduced greenhouse gas emissions, and heightened food security. My research has unearthed promising results. The preliminary findings indicate that agrivoltaic systems can significantly enhance sustainable food production and energy generation. In particular, the spinach crops grown under thin and thick solar panel shading sprouted faster, consumed less water, and grew more rapidly than those grown without any solar panel shading. I am committed to advancing my mission of promoting a more sustainable future. I firmly believe that by working collaboratively, we can create a better world.

Created by: Camila Quiroz
supervised by Guillermo Hernandez Ramirez



AW1, a novel Xanthomonas axonopodis pv. vasculorum bacteriophage

Created by: Ashlyn Waters
Supervised by Jonathan Dennis

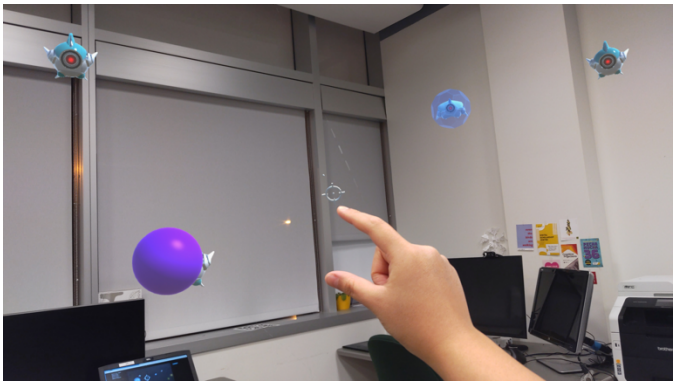
AW1 is a novel bacteriophage that I isolated from a sample of community planter soil using the bacterial strain *Xanthomonas axonopodis pv. vasculorum* FB570, a plant pathogen typically infecting sugarcane. This image, which is a transmission electron micrograph of AW1, represents one of the initial steps of phage characterization. To capture the image, high titre lysate of AW1 was stained with 4% uranyl acetate and imaged at x110,000 magnification. From this image, I was able to tentatively classify AW1 morphologically as a *Siphoviridae* and measure the dimensions of the tail and capsid as well. The isolation and characterization of AW1 has been a major project of mine over a summer research position and a BIOL 498 research course. Including imaging AW1, I have also characterized AW1 through preliminary host-range analysis, plaque morphology, and sequencing small segments of its genome. Excitingly, AW1 has also shown an ability to infect certain *Stenotrophomonas maltophilia* strains, a pathogen capable of human infection. Following extensive characterization, AW1 will hopefully be eligible as a potential candidate for use in treatment against bacterial infections by *Xanthomonas axonopodis pv. vasculorum* FB570, applicable *Stenotrophomonas maltophilia* strains, or other bacteria it is discovered to be capable of lysing.

Golden Canola

The photo displays a *Brassica napus* plant, better known as canola. This individual plant is one of thousands that are seeded throughout the year to aid in crop disease research. Canola plants are vital to the agricultural industry of Canada and are within the top most common field crops of Alberta and of Canada. Here at the University of Alberta in the department of Agricultural, Food, and Nutritional Science, we conduct experiments to cultivate canola plants that will be more resistant to crop diseases such as blackleg, sclerotinia stem rot, and clubroot. Crop disease research is ongoing and incredibly important to the continued success of the canola industry, especially from an economic standpoint. But canola is a livelihood for many researchers and crop farmers alike. I am personally honored to have been a part of this research. From seeding and inoculating the canola, to pulling the matured plants and washing their roots for disease-assessment, it comes full circle. When I'm driving along the highways of Alberta, I see golden fields of canola and it's quite fulfilling knowing that I played a small part in that. Especially considering that scientific research and agriculture are traditionally male-dominated industries. The women I work with, including my fellow coworkers, the graduate students, lab technicians, and my supervisor, all inspire me to persevere in whatever path I choose in life. The canola plant in the photo is a golden symbol of this.

Created by: Sabrina Strelkov
supervised by Sheau-Fang Hwang

Augmented Reality x Rehabilitation



Created by: Annie Wei
Supervised by Nathaniel Maeda and Martin Ferguson-Pell

This image shows the point of view of the patient in an augmented reality headset (Microsoft HoloLens 2) playing an interactive alien game designed to improve visual cognition. Virtual aliens are projected and dispersed within real space, overlaying the environment to enhance the visual sensory experience. These aliens, in different sizes and shapes, have the ability to duplicate and shoot back at the patients. They also travel at different speeds within 360

degrees, encouraging brain injury patients to move around, turn their heads and use eye scanning as part of visual cognitive therapy. The objective of the game is to destroy all aliens within a set time. Patients must first identify the aliens using head movement and eye scanning, then send out virtual shots by closing the thumb and index finger. Game statistics provide objective feedback on performance for patients and their attending clinicians. With this immersive and engaging augmented reality game created by Cognitive Projections members and NAIT (Northern Alberta Institute of Technology) developers, we want to investigate whether the gamification of therapy could improve patient adherence to visual cognitive rehabilitation. Our team visualizes that "therapy could be the most fun you've had all day. So why not?" and continues to develop and deploy applications for integration into healthcare. It has been quite fascinating for me as a Kinesiology student to take part in this novel solution for improving patient adherence and see first-hand the capacity technology has in augmenting rehabilitation through running clinical trials with patients and clinicians at the Glenrose Rehabilitation Hospital.

So Much More Than a Hug

In this picture I am hugging a tree after a long day in the field. This was taken during a scouting period on one of our trips. Being in the woods allowed me to connect with my roots & brought me closer to my culture. This picture is very representative of my summer and the impact and meaningfulness it had.

Created by: Acacia Lechot
with Jessica Chaves Cardoso and Charles Nock