Wired for Touch: The Neurons and Circuits That Make Us Human
Dr. Victoria Abraira (www.abrairalab.org)

Every time we step out into the world a multitude of stimuli are stamped onto the circuits of our brain by way of our sensory systems. There's a lot that we don't yet understand about all of our five senses, but touch remains particularly underexplored. Yet touch is one of the first senses to develop in utero and the only sense that if deprived of during early development can result in catastrophic consequences to our normal brain function. Our group utilizes the power of mouse molecular genetics to identify and manipulate touch circuits from the skin to the brain to decode our sense of touch, from pain to pleasure and everything in between.

Innocuous touch of the skin is detected by distinct population of sensory neurons, the Low-Threshold Mechanorecetors (LTMRs). A major obstacle to progress in innocuous touch circuit dissection is the difficulty in recognizing distinct populations of spinal cord neurons that receive and process LTMR information from the skin. To address this issue, we developed mouse genetic tools to label and manipulate ~80% of LTMR recipient neurons of the spinal cord (Abraira et.al., *Cell* 2017). Each of these neuronal populations segregate into previously uncharacterized classed of excitatory and inhibitory neurons, with unique morphological/physiological signatures and connectivity profiles. Ongoing work is centered around manipulating these different neuronal populations in the awake behaving mouse to understand the contributions of touch to health and disease.

These are some of the questions that we are asking with this technology:

1. What is the functional organization within the spinal cord that give rise to specific behavioral features related to pain and locomotion?
2. How do internal states (arousal, motivation, expectation) modulate somatosensory processing in the spinal cord dorsal horn?
3. How does touch shape our social brain?

GPA and other requirements for project (if application): 3.5 GPA; familiarity with spreadsheets, analysis software, etc.

Applicant responsibilities: Each day the student will be asked to spend several hours reconstructing neurons using the software Neuromantic. Each reconstruction can take on average 3 hours, so every day one can reconstruct 1-2 neurons. After the completion of a cohort of reconstructions, the student will perform analysis on the data collected using the GraphPad Prism software. The goal will be reconstructions of ~100 neurons.

About your mentor: Throughout my career I have mentored 30 undergraduate students and developed dozens of summer/thesis projects. All of my mentees have used this experience to further their scientific careers, many to attend graduate school and/or medical school. Thus, in my laboratory you will not only receive hands-on training on cutting-edge scientific research but you will also be working closely with me to build your resume and prepare you for the next step of your scientific career. Students in my lab work as a team, each individual tackling different aspects of the same overarching question, using multiple yet overlapping technical approaches that include mouse genetics, spinal cord histology and animal behavior. Your project will be carefully crafted and layered so that you can learn from your mentor (including me) as well as from each other. All of my undergraduate students meet with me individually and as a group on a weekly basis to craft their projects, go over literature and talk about results.

About your environment: My lab is both physically and thematically embedded within the Keck Center for Collaborative Neuroscience and the Spinal Cord Injury Project (**http://keck.rutgers.edu/**). The Center includes four full time staff (two lab managers, animal care/histology technician, imaging specialist) and several graduate students and post-doctoral fellows. All post-docs, students and staff on the Keck Center floor are well trained in spinal cord neurobiology and ready to help you during the summer. Finally, the Keck Center, through Wise Young, has a long-standing tradition of hosting and training several undergraduate research teams every summer. As part of my laboratory in the Keck Center, you will also be taking part in these vibrant summer activities, which include team meetings and presentations.