<u>Richard Axel Lab</u>

Neurogenetics, Sensory Physiology

Represented by Katie Shakman

The Axel lab studies olfactory processing in mice and flies as a window into perception and the neural basis of behavior. I work with the fruit fly Drosophila melanogaster on the neural circuitry of olfactory-driven avoidance. Some current projects include characterizing a type of dopamine neuron that is involved in learned behavior, dissecting how different types of dopamine neurons interact, and investigating the convergence of circuits for innate and learned behaviors. Opportunities for an undergraduate researcher include testing behavior of flies, characterizing anatomy of neuron subtypes, and hands-on experience in fly genetics.

<u>Randy Bruno Lab*</u>

Neuroscience

Represented by Kate Hong

The Bruno lab is interested in discovering how neural circuits in the brain mediates sensory perception. Using the rodent whisker system as a model, we focus on how the brain processes information about touch. We combine optogenetics, in vivo electrophysiology, and behavioral studies to examine the role of different cortical layers in sensory behaviors. By inactivating or activating different areas of the brain during behavior, we are probing the contribution of different areas in touch perception. Furthermore, we are using state-of-the-art viral tracing strategies to further define the anatomical map in regions associated with whisker-mediated behaviors. We are seeking a few bright and motivated students to help with 2 main projects: (1) A behavioral study to assess how cortical activity mediates learning. Students interested in gaining experience with animal behavior are strongly encouraged to apply. Behavioral testing is a rigorous process that requires regular training of animal subjects. At least a 2-3 hour commitment is preferred for 3-5 days a week. (2) An anatomical study using viral tracing strategies to map the connectivity of different areas within the circuitry mediating touch perception.

<u>Jahannaz Dastgir Lab*</u>

Neurology

<u>Dr. Andrew Dwork Lab</u>

Psychiatry

The Dwork lab is currently studying the neuropathology underlying psychiatric disorders.

<u>Wesley Grueber Lab</u>

Cellular Biophysics, Neuroscience

Represented by Anite Burgos and Jenn Ziegenfuss

Our lab uses anatomical, functional, and behavioral techniques to study the development and function of somatosensory neurons and their circuitry in Drosophila (fruit fly) larvae. We are also interested in understanding how these neurons change at the morphological, molecular, and functional level as an animal ages in an effort to discover ways of promoting long-term maintenance of the nervous system. We are looking for enthusiastic students who are interested in learning how the humble fruit fly, with its vast genetic toolkit and cell-specific manipulations, can be used to understand how neural circuits develop, function, and are maintained.

10th Annual Undergraduate Research Fair

Hosted by the Columbia Neuroscience Society

Saturday November 14th, 2015

1:00-3:00 p.m.

555 Lerner Hall

***Denotes Labs Unable to Attend but Interested in Recruiting Undergraduates**

<u>David Helfand, The Astrophysics Laboratory</u>

Astronomy

Represented by Maria Charisi

Gamma-ray bursts: Gamma-ray bursts (GRBs) are short, very energetic explosions that happen in distant galaxies. There at least two types of GRBs, short duration GRBs (<2sec) produced when two compact objects (e.g. two neutron stars or a neutron star and a black hole) collide and long GRBs (>2sec) that are associated with the catastrophic collapse of massive rapidly rotating stars. Although they have been studied for over 40 years, they remain puzzling. Research in GRBs enters an exciting era, as we are getting closer to the detection of more exotic signatures produced during those explosive events, such as neutrinos or gravitational waves. 2. Super Massive Black Hole Binaries: It is well known that every massive galaxies hosts a supermassive black hole in their centers. The black holes have masses between a million to a billion times the mass of the sun and are a significant component of the galaxy. We also know that galaxies grow as they collide with other galaxies. The end result of such a merger is the formation of a pair of black holes orbiting around each other. Although binaries at close separations are expected to be fairly common very few have been observed, a puzzle of great importance.

<u>Rene Hen Lab</u>

Integrative Neuroscience

Represented by Christoph Anacker

We study how stress and antidepressants affect brain function and behavior in mice. One of our main interests is in how antidepressants increase the birth of new brain cells in order to protect from the deleterious effects of stress on mood and emotion. We are using chronic stress models to induce depressive- and anxiety-like behaviors in transgenic mice in which we can increase or decrease neurogenesis. We are also imaging the live activity of brain cells using mini-microscopes which we can attach to the head of freely moving mice in order to visualize brain cell activity while mice are exposed to stress or antidepressant treatment. We are looking for motivated students who will be involved in all aspects of the project, including work with genetically modified mice, stress and behavioral experiments, antidepressant treatment, brain dissection, immunostaining, and in vivo imaging with mini-microscopes.

<u>Olver Hobert Lab</u>

Biophysics, Molecular Biology

Represented by Emily Bayer

The main focus of the laboratory is to understand the molecular mechanisms that generate the astounding diversity of cell types in a nervous system. Using the C.elegans model system, we have revealed a core regulatory logic for how terminal neuronal identity is controlled in several different neuron types. These insights have allowed us to reprogram the identity of heterologous cell types to that of specific neuron types. Aside from our main focus on neuronal development, we have also studied the molecular machinery with which the nervous system responds to the environment (i) to modulate behavior and (ii) to ensure that it maintains its functional and structural integrity.

<u>Laura Johnston Lab</u>

Genetics, Developmental Biology

Represented by Cora Bergantinos and Lale Alpar

My laboratory investigates the mechanisms used by growing tissues to gauge and regulate the collective and individual fitness of cells, thereby optimizing tissue and animal fitness. We are interested in the basic biological mechanisms that regulate these processes, how they contribute to development of healthy tissues and in understanding their relevance to developmental and tumorigenic pathologies. We use the simple genetic model organism Drosophila and utilize strategies that allow manipulation of growth and cell fitness in living, growing animals. Our projects include: how the growth regulator Myc mediates competitive interactions during tissue and organ growth; investigation of homeostatic processes, including metabolism, that allow cells to sense and respond to growth changes in their local environment; identification of factors that act as sensors and mediators of cellular fitness; and genetic and molecular dissection of tissue regeneration. These processes provide plasticity to growing organs and give cells control over their local environment.

<u>Christoph Kellendonk Lab*</u>

Psychiatry, Pharmacology

Represented by Eduardo Gallo

The lab's general focus is understanding the role of striatal dopamine receptors in schizophrenia. Our project in particular looks at how the mesolimbic dopamine system regulates motivation. We use adenoassociated viruses to overexpress D2 receptors in the nucleus accumbens in order to understand the activity of this circuit and the impact of overexpression of D2 receptors on behavior. Methods primarily include behavior testing and immunohistochemistry. (Not in attendance. Email efg2115@columbia.edu or ask for Jeremy at the sign-in desk if you are interested).

<u>Minoree Kohwi Lab</u>

Neuroscience

Represented by Adan Horta

We are interested in how neural stem cells give rise to incredibly diverse and unique neural cell types (over 100 billion in the human brain!). This is largely regulated by temporal dynamics of neural stem cell differentiation. In particular, we are focusing on a phenomenon called the competence window. When stem cells mature and divide, they lose the ability to become cell types that they could have become at a previous developmental time. This process is in part regulated by a change in the physical arrangement of chromatin in the nucleus, called the nuclear architecture. As our research progresses, we may find implications for developmental disorders, such as autism, and will gain a better understanding of neural stem cells that can potentially be used in neurodegenerative disorders, such as Alzheimers. To this end, we use molecular biology, immunohistochemistry, next-generation sequencing, and the model system, Drosophila. As a small lab, we are motivated and eager to help willing students learn to be scientists!

Erika Levy Lab

Speech Production and Pathology

Oren Levy Lab

Neurology

The overall goal of Dr. Levy's research is to identify neuroprotective targets and candidates for the treatment of Parkinson's disease (PD). His approach focuses on the use of cellular and animal models of PD, in order to study survival and apoptotic pathways at a molecular level. By understanding these pathways at this level of detail, the hope is to find interventions with the highest level of specificity to the pathologic target. A major focus in the lab is understanding the contribution of the conserved cellular coping mechanism, the integrated stress response, to neurodegeneration in models of PD.

Attila Losonczy Lab

Neuroscience and Behavior

Represented by Ali Kaufman

The goal of our research in the lab is to establish the links between the organization of neural networks and the behaviors they generate. We carry out investigations into this outstanding issue through functional analysis of the mammalian hippocampal circuit, which produces spatial and episodic memories. We perform calcium imaging *in vivo* to watch neuronal calcium activity during behavior. We are particularly interested in students with experience in electrical engineering, programming and analysis, or math and statistics.

Lena Mamykina Lab

Biomedical Informatics

Dr. Mamykina's broad research interests include an individual's sensemaking and problem-solving in context of health management, collective sensemaking within online health support communities, clinical reasoning and decision-making, communication and coordination of work in clinical teams, and ways to support these practices with informatics interventions. She also focuses on analysis of health information technologies and how they are used among critical care teams, as well as social computing platforms for facilitating knowledge sharing within clinical communities, and within online health support groups.

Richard Mann Lab

Biochemistry, Molecular Biophysics

Represented by Lalanti Venkat, Claire Howard and Meredith Peterson

We study Drosophila m as a model system for a range of problems related to how transcription factors coordinate complex processes during animal development. The lab is particularly interested in the Hox family of homeodomain genes, which code for transcription factors that specifiy tissue and cellular identities across the animal kingdom. The Hox projects address how these transcription factors are able to specifically regulate their target genes during development. Their studies have also focused on motor neuron differentiation in the fly leg, the development of the proximal-distal axis in leg development, and the regulation of tissue growth and organ size.

Undergraduate Public Health Program

Represented by Dana March

Ponisseril Somasundaran Lab

Earth and Environmental Engineering

Represented by Irina Chernyshova

Sustainable Energy and Materials focuses on innovative ways to provide energy and material resources to society, in a sustainable and environmentally responsible manner. The central task is to build and shape the energy and industrial infrastructure of the 21st century. Many projects focus on treating the inefficiencies and by-products of traditional production in novel ways, such as carbon sequestration, zero-emission coal, catalysis, and recycling technologies. Other projects focus on developing viable alternative energy sources, such as waste-to-energy.

Organic Chemistry Collaborative Center, Milan Stajanovic

Experimental Therapeutics, Chemistry

Represented by Stevan Pecic

The lab is engaged in several long-term projects, and has extensive experience in designing nucleic acid-based biosensors, the synthesis of small molecules as probes for target validation for drug discovery, and for elucidation of physiology and pathophysiology; structure-activity relationship (SAR) studies; various biological assays; molecular modeling and isolation and spectroscopic identification of natural products. We are looking for students to join teams working to discover novel small molecule therapeutics and biological probes such as: soluble epoxide hydrolase (sEH) inhibitors, reactivators of organophosphate compounds (OPC) and fatty acid amide hydrolase (FAAH) inhibitors. They will also work to isolate aptamers - oligonucleotides (ssDNA), 20-60 basis, that bind to a wide range of target molecules (drugs, proteins, nucleic acids, etc.) and that can be used as therapeutics or diagnostic tools in various diseases and/or medical conditions. In order to isolate these aptamers we use SELEX, a technique that is modified and well-established in our lab.

Theoretical and Computational Poromechanics Laboratory, Steven Sun

Civil Engineering

Theoretical and computational solid mechanics, poromechanics and multiscale modeling of fully coupled multiphysical systems. C++, matlab python, and finite element analysis are widely use inside the group.

Raymond and Beverly Sackler Laboratory for Neural Engineering and Control

Biomedical Engineering

Qi Wang

Our research interests lie in Brain-machine interfaces, Neural coding of tactile sensations, and Biomedical instrumentation. More specifically, we utilize experimental and theoretical approaches to investigate how the brain extracts information about the outside world through the electrical activity of neurons (reading the neural code), and how we shape downstream population neural activities, and ultimately perception, through patterned microstimulation (writing the neural code). The long-term goal of our research is to provide the bridge to clinical applications.

Jian Yang Lab

Biology

We focus on voltage-gated calcium channels (VGCCs) and transient receptor potential (TRP) channels. Both types of channels, when open, lead to membrane depolarization and calcium influx; thus, they not only increase cell excitability but also affect cellular calcium signaling. VGCCs are present in neurons, muscles and other excitable cells, and they open in response to membrane depolarization. They are vital for diverse biological processes including muscle contraction, neurotransmission, neurodevelopment and gene expression. TRP channels are more ubiquitous and are activated by more diverse mechanisms, including intracellular or extracellular ligands, mechanical stretch, temperature as well as changes in membrane voltage. TRP channels are involved in numerous biological processes, and they play an especially important role in vision, taste, hearing, touch, olfaction, temperature sensation, and other senses.

ZLab, Tanya Zelevinsky

Physics

Represented by Mickey McDonald

Our lab is working to adapt the successes of precision atomic clocks to molecules. By probing a cloud of ultracold atoms with a precisely-tuned laser, these atoms can be "glued together" into very weakly bound molecules, which can then be transferred into more interesting quantum states for further study. Our long-term goal is build a "molecular clock", which would make use of not transitions between different electronic excited states as its oscillator, but rather the vibration of the molecule itself. Such a clock could be used to look for new physics, such as a purported time variation in the ratio of the electron mass to the proton mass believed to exist in several beyond-the-standard-model theories. In the short term, we are developing new techniques for precision quantum chemistry, learning how to control every quantum mechanical degree of freedom in molecules and collaborate with theorists to predict their structure from first principles. Our current project involves studying one of the simplest chemical reactions of all, involving the absorption of a single photon by a molecule, which subsequently "explodes" into atomic fragments. When the molecule is prepared in different initial quantum states, the explosion patterns differ dramatically, revealing subtle quantum effects and information about the structure of the molecule itself (as well as creating beautiful images of firework-like rings).

Xin Zhang Lab

Ophthalmology

Represented by Revathi Balasubramanian

The lab works primarily on cell signaling pathways in eye development. My current project focuses on establishing the roles of two growth factors - FGF and WNT, in retinal development. We have established genetic mouse models to delve into the specifics of cell-cell signaling and the interplay between FGF and WNT pathways. I am looking for a motivated undergraduate to work with me on this project. The student will be exposed to very many wet-lab techniques such as PCR, gel electrophoresis, cryo-sectioning, immunohistochemistry, recombinant/plasmid DNA manipulations and in-situ hybridization.

CNS Upcoming Events

NeuroMajors Forum
November 20th 6:30pm Satow Room Lerner
NeuroLinguistics Panel Part II
Monday November 23rd 8:00pm Hamilton 602
Neuroscience in Philosophy
Thursday December 3rd 8:00 Hamilton 516