The research faculty at Rosalind Franklin University of Medicine and Science engage in a broad array of investigation in biomedical sciences. As seen in the following pages, individual faculty members have primary affiliations within administrative units. However, the diversity of interdisciplinary and collaborative research is the primary characteristic of our research faculty. Their topics of research are defined by their own research interests, by their own questions and by the scientific curiosity of their research teams. As a member of a research group, you will have the opportunity to learn from, work with and contribute to nationally and internationally recognized research laboratories.

### FACULTY RESEARCH INTERESTS

- Biochemistry and Structural Biology
- Cell and Molecular Biology
- Development, Regeneration and Stem Cells
- Genomics and Proteomics
- Immunology, Microbiology and Virology
- Neuroscience
- Physiology and Metabolism

### PRIMARY PROGRAM AFFILIATIONS

- Biochemistry and Molecular Biology
- Cell Biology and Anatomy
- Cellular and Molecular Pharmacology
- Microbiology and Immunology
- Neuroscience
- Pharmaceutical Sciences
- Physiology and Biophysics
Kenneth D. Beaman  
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Our laboratory is interested in the cellular and molecular mechanisms that control the immune response in pregnancy, tumor growth and invasion. Specifically, we study how normal pregnancy allows and supports placental growth, as a model of controlled growth and invasion. While immune tolerance supports fetal growth, the body often inappropriately supports certain cancers. Unlike cancers, pregnancy is terminated at parturition and the remaining tissues are resorbed by the body. We use this model to investigate both cancer and spontaneous abortion. Our primary focus of research is to understand the immunological and the molecular mechanisms of fetal-specific immune suppression during pregnancy, in order to create possible new techniques for the immune detection and therapy of ovarian and breast cancer.

Neil Bradbury  
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The Bradbury lab is focused on the protein trafficking of ion channels and kinases within polarized epithelial cells. Numerous human diseases are associated with abnormal protein trafficking, including Cystic Fibrosis, secretory diarrhea and prostate cancer, which are all studied in the lab. Complementary methods of biochemistry, electrophysiology, fluorescence and live cell microscopy are employed to answer fundamental questions, and to identify novel therapeutic targets to treat patients with Cystic Fibrosis or prostate cancer. Cutting edge studies are relying heavily on the use of mini-organs from mouse and human tissues to advance our research.

Robert Bridges  
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The laboratory investigates regulation of epithelial cell ion transport with a special focus on epithelial cell ion channels. A wide range of electrophysiological methods and video imaging are used to study the regulation, pharmacology, and biophysics of ion channels including CFTR, ENaC and various potassium channels. Research works toward development of drugs for treatment of Cystic Fibrosis and Chronic Obstructive Pulmonary Disease.
Dr. Buolamwini’s research is in the area of drug design and discovery, and experimental therapeutics in several disease areas, primarily heart disease, cancer, HIV/AIDS and Alzheimer’s disease. He is an inventor on several patents on novel bioactive molecules. His research has been continuously funded for over 20 years by agencies such as the American Heart Association, National Heart Lung and Blood Institute, National Cancer Institute, National Institute of Allergy and Infectious Diseases, National Institute of General Medical Sciences, National Institute on Aging, the Alzheimer’s Association and the Alzheimer’s Drug Discovery Foundation.

John Buolamwini
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Dr. Chang’s research focuses on strategies of treatment and prevention for infectious and non-infectious diseases through understanding molecular mechanisms of microbial virulence. Biological models studied include parasitic protozoa in mammalian cells and endosymbiotic bacteria in insects and protozoa. His work has been focused on Leishmania model for microbial virulence. The key concept is the separation of invasive/evasive determinants responsible for infection and pathoantigenic determinants for immunopathology as the manifestation of the disease or virulence phenotype. Other ongoing projects include genetic dissection of the unique metabolic defects in heme biosynthesis of trypanosomatid protozoa for exploitation for photodynamic vaccination. Currently active project is focused on the development of oxidatively photo-inactivated Leishmania as a universal platform for safe and effective delivery of multivalent vaccines against infectious and malignant diseases.

Kwang-Poo Chang
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The laboratory investigates protein and RNA interactions central to cellular and viral processes, ranging from expressing genes to directing cell mortality. These processes are highly dynamic in involving RNA-RNA and RNA-protein structural rearrangements. Yet it remains poorly understood how these processes are directed and regulated. The research group identifies and investigates the function of proteins that are essential for ribosome biogenesis — a vital cellular process that is emerging as an unexplored target for cancer treatment.

Carl C. Correll
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The goal of research in the Dabrowska Lab is to understand the neurobiology of defensive behaviors and fear-anxiety discrimination. Studies address how stress exposure can lead to neuroplasticity of selective neuronal circuits and long-term changes in stress-coping strategies, which ultimately can lead to development of anxiety disorders like a post-traumatic stress disorder (PTSD). Studies address how stress interacts with affect at the molecular, cellular, physiological and behavioral level, and their respective roles in the etiology of the mental disorders. To understand the complex endpoint of psychiatric disorders, the laboratory utilizes animal models of stress, anxiety, fear, and addiction to examine how disruption of these mechanisms could lead to the development of disease.

The laboratory investigates the developmental biology of skeletal muscle formation using a variety of paradigms and model systems. Much of our research focuses on the cellular and molecular mechanisms that regulate the development and differentiation of distinct skeletal muscle fibers and their respective phenotypes. The laboratory also investigates the mechanisms that control myogenic stem cell proliferation versus differentiation in models of neuromuscular disease.

The laboratory’s research interests are focused on the interdigitation of stress and pain pathways. A systemic approach is used to examine the contribution of subsets of GABAergic neurons in the amygdala to the generation of affective disorders. The experimental designs employ transgenic mice lines and apply technologies such as viral vectors and pharmacogenetics to discover and describe the function of various neurotransmitter systems on pain-associated mood disorders.
Mirek Dundr
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The laboratory addresses fundamental questions concerning the understanding of the dynamic organization of genome function within the cell nucleus in health and disease: How are nuclear domains maintained in the membrane-less interior of the nucleus in healthy and cancer cells? How are transcription and RNA processing complexes regulated within the nucleus? What are the molecular mechanisms that coordinate the functions of these complexes in the highly dynamic nuclear environment? The laboratory studies these aspects of nuclear functions and gene expression using high resolution imaging combined with molecular biology/biochemical approaches.

Lisa Ebihara
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Dr. Ebihara studies the biophysical and pharmacological properties of gap junctional channels and calcium-activated chloride channels in the lens of the eye and other tissues. One of the current areas of interest in the field of eye research is to understand how these proteins contribute to lens homeostasis and how cataracts and presbyopia arise. A major aim of Dr. Ebihara’s research is to obtain a detailed understanding of the biophysical properties of cloned lens gap junctional proteins and to localize the molecular determinants of permeability and gating of the gap junctional channels. Another aim is to examine the functional consequences of mutations of Cx50 and Cx46 found in congenital cataract patients.

David N. Everly
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The research of the laboratory is contributing new insights into mechanisms that induce the growth and ensure the survival of cancer cells. The rationale is that these new insights will lead to new and novel therapeutic strategies to treat virus-associated cancers. Such strategies would block the growth of tumors or induce the killing of the tumor cells. Furthermore, viral proteins often impinge on critical cellular pathways. Understanding how these proteins influence normal cellular pathways to induce cancer may lead to strategies to inhibit the growth of other cancers whose growth is regulated in similar ways.
**William N. Frost**  
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The laboratory investigates how neural networks process information, store memory and generate behavior using an array of techniques, including behavioral studies, intracellular electrophysiology, optical recording of network activity with voltage sensitive dyes and realistic computer simulations of the networks under study. Studies utilize an invertebrate model system with large, individually identifiable neurons allowing dissection of their respective roles in network function. By focusing on issues common to all animals, the laboratory seeks general principles of how networks of neurons perform their functions.

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**Raul J. Gazmuri**  
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Dr. Gazmuri is the Director of the Resuscitation Institute and leads a research team focused on developing novel therapeutic approaches to the acute management of life-threatening crises including cardiac arrest, hemorrhagic shock, septic shock, and traumatic brain injury using various small and large animal models. The work is complemented with research examining the role that mitochondria play on these acute life-threatening crises using a wide variety of molecular techniques, currently focused on exploring options for improving oxygen utilization efficiency.  
Dr. Gazmuri is also Director of Critical Care at the Captain James A. Lovell Federal Health Care Center, which helps lead his research with strong clinical translational emphasis.

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**Marc J. Glucksman**  
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The research program involves:
1. Biomarker discovery in several neuro-based disorders such as Alzheimer’s Disease and schizophrenia as well as diabetes utilizing proteomics.
2. Explicating novel neuropeptides involved in normal and disease states of feeding/obesity, aging and reproductive processes with mass spectrometry, and high throughput screening and x-ray diffraction.
3. Collaborating with genomicists to identify the mechanism of gene-causing mutations.
Adrian Gross
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The laboratory studies the structure and function of ion channels, a family of membrane proteins that play many key roles in neuroscience and which are a major target of essential drugs used in clinical medicine. The lab uses both structural and functional approaches. The main techniques employed are x-ray crystallography, site-directed spin labeling and electrophysiology to resolve dynamic structural changes that occur during function. By combining these powerful and yet complementary techniques, the laboratory takes a multi-pronged approach to the long-term goal of achieving a mechanistic understanding of ion channel function.

Michelle Hastings
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The Hastings laboratory investigates the molecular basis of a broad spectrum of human disease. Mechanisms of pre-mRNA splicing and regulation of alternative splicing are studied as they relate to disease impact. The principles and insights learned from these studies are applied to determine how splicing is deregulated or can be targeted for therapeutic value in conditions such as Alzheimer’s disease, Batten disease, Parkinson’s disease, Cystic Fibrosis, Usher syndrome and others. Non-coding regulatory microRNAs are also studied in the context of specific disease states.

Johnny He
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Dr. He’s research focuses on the molecular biology of host-virus interactions. His long-term goal is to understand how human cells interact with HIV/HCV viruses and to develop therapeutic strategies specifically targeted at these interactions. Specifically, he is interested in determining what cells are infected by HIV/HCV, how these cells are infected by HIV/HCV, what host factors are needed to support virus replication, how these infections alone or in combination ultimately lead to diseases, how the pathogenesis can be intervened. In addition, he has long-term interest in cancers and stem cell biology, particularly in tumor microenvironment and metastasis and regulation of stem cell pluripotency.
The laboratory’s research focuses on neural circuits controlling respiratory-related rhythmic motor behaviors in mammals. Our experiments utilize an advanced optical technique called holographic photostimulation in networks controlling breathing to understand how rhythmic behaviors emerge from dynamic activity in the brain.

Dr. Kaplan’s research focuses on the functioning of the human plasma membrane citrate transporter (PMCT) as this carrier is key to the energy metabolism of numerous cell types. Its functioning has been linked to the bioenergetics of lifespan, obesity, type 2 diabetes, and certain cancers depending on the model organism. Our program currently focuses on development of approaches to inhibit the functioning of this transporter of fundamental importance.

Dr. Johnson’s research investigates the neurobiological basis of cognitive aging, with a particular focus on mechanisms responsible for age-related memory loss under healthy versus pathological conditions. Work in the lab uses rat models of aging, combining maze- and touchscreen-based behavioral assessment with in vivo neurophysiological recordings, circuit-wide mapping of neural activation, and targeted manipulation of neural activity. Current projects focus on how the brain’s sensitivity to new information is altered in aging, and whether drugs targeting catecholamine neurotransmitters that provide novelty signals could prove useful in alleviating age-related cognitive decline.

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Ronald S. Kaplan
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Dr. Kaplan’s research focuses on the functioning of the human plasma membrane citrate transporter (PMCT) as this carrier is key to the energy metabolism of numerous cell types. Its functioning has been linked to the bioenergetics of lifespan, obesity, type 2 diabetes, and certain cancers depending on the model organism. Our program currently focuses on development of approaches to inhibit the functioning of this transporter of fundamental importance.
Donghee Kim
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Our laboratory investigates the role of ion channels in the modulation of cell excitability in response to various physicochemical stimuli such as heat, cold, acid, hypoxia, and noxious chemicals. The current research focuses on the mechanisms by which ion channels expressed in chemoreceptor cells of the carotid body detect changes in arterial oxygen pressure and alter calcium signaling to regulate transmitter secretion and ventilation.

Hongkyun Kim
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Dr. Kim’s laboratory utilizes the C. elegans model system to address fundamental questions in cell biology related to the pathogenesis of disease. Using genetic and genomic approaches, the research focuses on protein-protein interactions and protein function in the manifestation of specific neurologic and neuromuscular diseases.

Min Lu
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The research group utilizes x-ray crystallography as a primary tool to study the structure and mechanism of medically important membrane transport and channel proteins. The long-term goal of the research is to gain a deep understanding of transport mechanism, substrate selectivity and functional regulation. The laboratory focuses on bacterial proteins that utilize a preexisting proton or sodium gradient to transport their substrates across the cell membrane as well as integral membrane proteins that transport RNA molecules in eukaryotic cells.
Robert Marr
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The overlying area of Dr. Marr’s interests lay in the study of neurodegenerative diseases. More specifically his focus is on Alzheimer’s disease and the use of gene transfer vectors as a tool to investigate specific gene function(s) in the brain as it relates to Alzheimer’s. The derivation of potentially new therapeutic approaches to Alzheimer’s disease is also an area of focus for Dr. Marr, as well as the role of Alzheimer’s related genes in the process of traumatic brain injury. Finally, his laboratory has been working on the use in induced human neurons to model aspects of dementia and for their application to regenerative medicine.

Gustavo Martinez
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The overall goal of the laboratory is to understand the transcriptional and epigenetic regulation of CTL differentiation and function. In particular, we are interested in elucidating how epigenetic modulators as well as NFAT family members regulate CTL differentiation during infections and cancer. The molecular basis for how transcriptional specificity within members of the same family is achieved is unclear. We are investigating how NFAT family members achieve binding site selectivity in cis-acting regulatory DNA in vivo to mediate their specific and overlapping transcriptional programs during the activation and differentiation of T lymphocytes.

David M. Mueller
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The Mueller laboratory is working on two disparate, yet related, projects that incorporate common tools. In the first project, the laboratory investigates the structure/function relationship of the mitochondrial ATP synthase and the structural bases for inhibitor and drug binding to the ATP synthase. In the second project, the laboratory studies the molecular function, structure, and regulation of the gene product defective in the neurodegenerative disease, Batten disease and in general, the mechanism of neurodegeneration. Our studies utilize crystallography, cryo-electron microscopy, biochemistry and yeast genetics depending on the questions that are being asked.
Dr. Oh’s research focuses on the primary pathogenic event in Duchenne muscular dystrophy, which is muscle cell necrosis followed by regenerative responses, by using a C. elegans model of muscular dystrophy in which loss of dystrophin causes progressive muscle cell death as in mammals, and muscle cell death can be prevented by modulating signaling pathways. The laboratory is investigating roles of IGF-1 signaling and stress responses in dystrophic muscle cells.

Using various biochemical methods and biophysical methods, Dr. Oh’s laboratory aims to delineate the mechanism by which the pore-forming BCL-2 proteins become activated by other pro-apoptotic BCL-2 members and how they are organized within the membrane-pore. In particular, using a powerful biophysical method known as the site-directed spin labeling (SDSL) approach of electron paramagnetic resonance (EPR) spectroscopy, the laboratory is studying the structure of the BCL-2 proteins in the membrane-inserted state. Detailed structure/function information will provide novel insights to facilitate identification of drug targets for controlling the apoptotic sequences that occur in many diseases.

The laboratory is focused on the recruitment of endogenous stem cells as an approach to fulfilling the promise of personalized regenerative medicine. The goal is to activate these cells, expand their numbers, and direct their differentiation to support the repair process. The research addresses three important issues in tissue stem cell recruitment: repair of the brain, cutaneous wound healing, and understanding the capacity of stem cells in aging tissue in neurological injury, aging and various disease states such as diabetes.
Our aim is to contribute to the understanding of how cells regulate the membrane transport of solutes under physiological and pathophysiological conditions and how music modifies our brains. We have 3 main collaborations: 1) with Dr. Robert Bridges we study the mechanisms by which exposure to hyperosmotic inhalers benefit Cystic Fibrosis patients; 2) with Dr. Hawkins we study the mechanisms of transport of taurine across the brain-blood barrier; 3) with Dr. John Calamari we study how music can be used as a therapeutic tool to treat dementia and Alzheimer's in the elderly.
A dysfunction in the production, influence or perception of emotion is at the core of several psychiatric disorders. This laboratory focuses on key brain regions that are involved in emotion and dysfunctions of these regions in models of psychiatric disorders. Current research explores the neurobiology of sex differences and age differences in the function of these brain regions. A long-term goal of this work is to discover novel targets to alleviate mood-related symptoms of psychiatric disorders.

The overall goal of the laboratory is to further understanding of mechanisms governing inflammatory responses and mucosal immunity. Research is currently focused on the role of the IL-17 family of cytokines in the promotion of inflammation and disease. Specific research projects ongoing in the lab include the regulation of IL-17 production by T lymphocytes, IL-17C signaling in intestinal epithelial cells and additional IL-17 cytokines. The laboratory is interested in examining the regulation and function of the more poorly described members of this cytokine family.

The laboratory utilizes the electrophysiology techniques of patch and whole-cell voltage clamping to investigate ion channels in non-excitable cells. Work has focused on channels in the proximal tubule and collecting duct of the kidney, with particular emphasis on permeation and gating of inward rectifier K channels (Kir) using both heterologous expression of channels in Xenopus oocytes and direct incorporation of channel protein into liposomes. Site-directed mutagenesis of Kir channels has helped to define the structural basis for a primary ligand gate at the bundle-crossing of inner transmembrane helices as well as a secondary K-dependent gate at the selectivity filter, operating in series with the bundle-crossing gate.
Neelam Sharma-Walia
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The laboratory studies focus on the cell signaling pathways associated with viral infection and subsequent disease. Research focuses on the arachidonic acid and prostaglandin pathways in endothelial cells during Kaposi's sarcoma-associated herpes virus (KSHV) pathogenesis. Analyses extend to KSHV pathogenesis-related events like inflammation, invasion, angiogenesis and cell survival. Using a variety of cutting-edge technologies, the laboratory is currently deciphering the role of prostaglandin pathway in KSHV episome maintenance and chromatin remodeling.

Michael P. Sarras
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The long-term objective of the laboratory is to decipher the molecular mechanisms of metabolic memory with a rationale that these studies will lead to the identification and development of novel therapeutic targets to control the progression of diabetic complications. To this end, the laboratory developed an adult zebrafish model of type 1 diabetes mellitus using the diabetogenic drug, streptozocin. Dr. Sarras’ group has characterized this model to show that diabetic zebrafish display the known secondary complications of diabetes including impaired epidermal wound healing, altered blood vessel growth, impaired limb regeneration. Data indicate that epigenetic changes are associated with the DM state, and current translational studies are underway in tissues of diabetic patients. Most currently, we have initiated translational studies with Mayo Clinic, Rochester, MN to investigate if the same mechanisms identified in the Zebrafish can be identified in human endothelial cells isolated from the maternal placental of women with Gestational Diabetes mellitus (GDM). GDM is a temporary condition in women that mimics the conditions we created in our Zebrafish diabetic metabolic memory model.

Heinz Steiner
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The laboratory focuses on the functional organization of the basal ganglia and related brain systems, especially on the role of the neurotransmitter dopamine in the regulation of basal ganglia–cortical interactions. Research aims to understand how pathologically altered activities in transmitter systems such as dopamine cause neuroadaptive changes in neurons of the basal ganglia and their functional consequences. Current projects investigate how chronic enhancement of dopamine actions [e.g., by psychostimulants such as cocaine and methylphenidate (Ritalin)], or their attenuation (e.g., by antipsychotic drugs or dopamine depletion), produce changes in gene regulation, and how these molecular alterations affect basal ganglia function and behavior.
Grace E. Stutzmann
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The Stutzmann laboratory focuses on early neuronal pathophysiology in neurological disorders such as Alzheimer’s disease (AD) and traumatic brain injury. Using tools such as transgenic mouse models and transformed human neurons, studies examine alterations in neuronal function and synaptic transmission across various stages of the disease process, with the goal of developing novel therapeutic strategies to block or reverse these disease-associated impairments. Relying heavily on electrophysiological and optical imaging approaches, the research focuses on intracellular calcium signaling pathways that interfere with proper neuronal physiology, synaptic plasticity processes involved in learning and memory, and protein handling mechanisms. The strategy is to normalize aberrant signaling pathways prior to the formation of late-stage disease markers through novel drug discovery and use of human neurons generated from iPSCs.

Janice Urban
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The laboratory’s research is focused on understanding the contribution of neuropeptide systems within the hypothalamus and amygdala to modulating behavioral and endocrine responses to stress. The goal of this research is to elucidate the pathways and cellular mechanisms in the brain involved in the generation of stress resilience and vulnerability in males and females. This research will be useful for preventive and therapeutic treatment of anxiety-related disorders.

Barbara Vertel
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The main focus of the laboratory’s research is intracellular events in subcellular compartments that reveal underlying mechanisms for the synthesis, processing and quality control of cartilage matrix molecules and other secreted or membrane proteins in normal cells, and as the basis of disease. Immunohistochemical, biochemical and molecular approaches are used with live cell imaging to develop a broad view. Immunolocalization at the levels of light and electron microscopy is used to visualize coordinate biosynthesis and matrix deposition, while biochemical studies provide complementary information about processing and biosynthetic intermediates of matrix molecules. Specific attention has been directed to models of chondrodysplasias and cataracts.
Research is in the application of computer modeling to drug design, protein structure-function relationships and drug-receptor interactions. Molecular mechanics, molecular dynamics and electronic structure calculations provide insight into events at the molecular level that are not easily studied experimentally. Current problems of interest include the application of computer-aided drug design methodology to the discovery of new anti-viral drugs, mechanisms of sweet and bitter taste transduction, and modeling of ion channels and transporters.

Our research efforts are focused on understanding how chronic inflammation caused by obesity impinges on the microvascular system. We are currently studying how macrophages are recruited to fat deposits surrounding the microvasculature and how they communicate with the underlying vessels. We do this by manipulating the immune system in mouse models of obesity and examine vascular function in vivo and in vitro using live confocal imaging microscopy. Ultimately, the goal is to determine if microvascular dysfunction can be treated by targeting the immune system.