Boise State Internship Opportunities for ICOM students, Summer 2022

Location: Membrane Biophysics Lab, Boise State University

PI: Daniel Fologea, PhD

1. Liposomes as nano-carriers for drug delivery

   Description: This project focuses on developing liposomes for targeted and controlled drug delivery in the human body. Liposomes prepared by extrusion will be loaded actively and passively with the drugs of interest, and the load will be assessed by employing spectroscopy and microscopy techniques. The liposomes will also be functionalized with specific ligands for enabling targeting of desired sites and endowed with mechanisms for controlled drug release upon physical or chemical stimulation. The assessments include loading the liposomes with drug simulators, Doxorubicin (for cancer therapy), and nucleic acids (for gene therapy). Surface functionalization will be achieved by utilizing biomarkers and aptamers, and the release of the drug will be triggered by mild hyperthermia, radiation, external electric fields, or chemical stimulation. The use of carriers for drug delivery is anticipated to lead to a better clinical outcome by providing the means to achieve larger local concentrations of active drugs while minimizing the systemic effects. Through this project, the intern students will gain experimental skills on liposome preparation, characterization, and bioconjugations, together with the opportunity to mentor undergraduate, graduate, and high school students in a multidisciplinary environment. The project is an ongoing one, and the students may choose to dedicate 5 weeks (full time) or 8 weeks (part time) during the summer.

2. Investigations on the transport properties of ion channels

   Description: This project aims at investigating the transport properties of channels reconstituted into artificial membranes. The directed transport of ions and molecules across cell membranes is essential for creating and maintaining electrochemical gradients, nutrition, information transmission and processing, and energy production. Any disturbance in the functionality of ion channels may lead to abnormal cellular physiology and even cellular death. To achieve their physiological role, ion channels present three major features: high transport rate, regulation, and selectivity. This project employs reconstitution of channels into planar lipid membranes and electrophysiology measurements of their transport properties. The students employed in this project will learn preparation and characterization of bilayer lipid membranes, techniques for channel reconstitution into membranes, and electrophysiological characterization of transport rate, regulation by voltage and ligands, and selectivity. The students will also be provided the opportunity to share knowledge with a multidisciplinary team, as well as mentoring undergraduate, graduate, and high school students in the lab. The project is an ongoing one, and the students may choose to dedicate 5 weeks (full time) or 8 weeks (part time) during the summer.

Location: Department of Physics, Boise State University

PI: Laxman Mainali, PhD

Dr. Mainali's lab focuses on studying the structure, dynamics, and function of model and biological membrane in the systems relevant to human health and diseases. Specifically, my group is working on two major research projects:

1. **Interaction of alpha-crystallin with cholesterol bilayer domains in cataract formation:** A great deal of evidence suggests that the amount of membrane-bound alpha-crystallin increases with age and cataract progression. I hypothesized that the high cholesterol content and the formation of pure cholesterol bilayer domains decrease alpha-crystallin's binding to the lens membrane, which should protect against cataract development. These studies will provide alternative strategies for preventing and slowing cataract progression.

2. **Cholesterol membrane domains and cholesterol crystals in atherosclerosis:** The primary goal of this research is to understand the function of cholesterol, cholesterol bilayer domain, and cholesterol crystals in the initiation of the atherosclerotic process. The findings of this research should indicate new potential strategies and targets for the therapy of this disease.

State of the art electron paramagnetic resonance (EPR), atomic force microscopy (AFM), differential scanning calorimetry (DSC), circular dichroism (CD), dynamic light scattering (DLS), and fast protein liquid chromatography (FPLC) approach is used in the above research projects to answer fundamental questions on the molecular level that will help explain the causes and mechanisms of cataract and atherosclerosis. ICOM students will have the opportunity to work closely with PI and the postdoctoral fellows in the lab. Depending upon the student research interest, ICOM students will have the opportunity to develop skills in sample preparation (membrane or lipid-protein samples), biophysical instrumentation (EPR, DSC, CD, DLS, and FPLC), and data analysis

Location: Boise Applied Biomechanics of Infants (BABI Lab)
PI: Erin Mannen, PhD

Bio:
Erin Mannen, PhD, is an Assistant Professor of Mechanical and Biomedical Engineering and Director of the Boise Applied Biomechanics of Infants (BABI) Laboratory at Boise State University (https://www.boisestate.edu/coen-babi/). The BABI Lab focuses on understanding how babies move and use their muscles, and what that means for safety and musculoskeletal development. The lab works closely with clinicians and industry to ask relevant questions to improve the health and well-being of babies. Dr. Mannen has received substantial external funding and has many recent research publications. Dr. Mannen is recruiting up to *4 ICOM students* (depending on qualifications) to volunteer in her lab. For both projects, students will be expected to spend ~6 hours on the research each week during the academic year (with the exception of finals weeks and other personal time), and up to 20 hours/week during the summer. In general, students will coordinate schedules with one another and with your graduate student colleagues in the BABI Lab. Many duties may be performed off campus with flexible hours. ICOM students who contribute meaningfully over a sustained period of time will likely be co-authors on publications.

#1 How do babies roll? The goal of this project is to collect a large set of video data from babies in a home setting to understand how they coordinate rolling, and how that changes over time. 2 ICOM students will be responsible for managing an IRB-approved longitudinal study to collect survey data and video files from caregivers of their infants rolling over. All data collection will be online, but we hope to collect over 1000 videos in a 1-year period. Students will manage all aspects of the study, working on advertising and recruiting, corresponding with study participants, arranging for compensation for participation, and organizing and processing data. In the future, we will utilize image-processing software to evaluate and quantify the coordinated movements of rolling. This project will be submitted as abstracts to biomechanics and pediatric conferences, with eventual manuscript publications in related journals.

#2 Infant Anthropometric Literature Review. The goal of this project is to write a comprehensive literature review article of infant anthropometric measures of hip throughout the first year of development. 2 ICOM students will be responsible for designing a literature review (with the help of researchers in our lab and the Boise State Librarians), critically assessing the articles, and assembling and writing a comprehensive review article on infant anthropometry of the hip during the first year of life. I hope to have a completed manuscript ready for submission to a journal by the end of the 1-year project.

Location: Translational Health Lab, Boise State University
PI: Luke Montrose, PhD

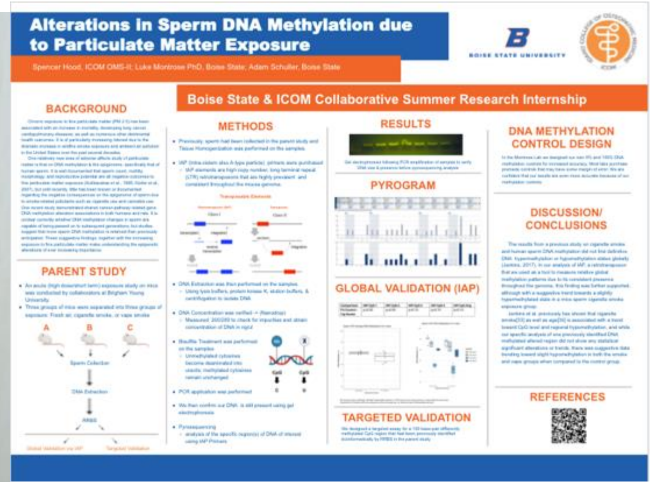
The Montrose Translational Health Lab at Boise State University aims to translate basic science into practical clinical and community solutions. Dr. Luke Montrose is an environmental toxicologist with research interests in public health, exposure assessment and chronic illness, particularly as it relates to vulnerable and understudied populations. As an Assistant Professor in the Public Health and Population Science at Boise State University, Dr. Montrose is positioning himself to work collaboratively across the region with relevant stakeholders to enhance community resilience through research on the health effects of wildfire smoke exposure.

We are seeking a summer intern student to evaluate the feasibility and establish a draft protocol for collecting sperm from wildland firefighters. This is a timely project given the increase in wildfire activity and enhanced risk for exposure among firefighters. A growing body of literature suggests that environmental exposures can impact male fertility and possibly offspring health via alterations to the sperm epigenome. Our lab recently demonstrated that simulated wildfire smoke can alter sperm DNA methylation in exposed male mice. However, similar studies have never been conducted in a human cohort and there are many logistical and ethical challenges that must be considered.

The student will have a unique opportunity to conduct a brief and targeted literature review, consult with local practitioners (e.g., urologists and occupational health physicians), develop relationships with relevant stakeholders (e.g., wildland firefighters, CDC/NIOSH representatives), and engage with the university Institutional Review Board. A highly motivated student may also have the opportunity to observe sperm extraction from a model organism and gain hands-on experience in molecular techniques such as DNA extraction, polymerase chain reaction (PCR) and gel electrophoresis. The intern will attend our weekly laboratory meetings, where the student will hear about other ongoing projects and give at least two presentations, one will be a journal club presentation and the other will be an update of their own project. The expected deliverable from the internship will be a poster that can be shared at an ICOM research seminar or at a local/regional conference as applicable.

A good fit for our lab would be someone who has an interest in reproductive biology, environmental toxicology, epigenetics, or biomarker research and has some experience with basic laboratory techniques as well as good written and interpersonal skills. Primary mentorship for this project will come from Dr. Montrose, but daily activities will be supervised by a rising 3rd year Biomolecular Sciences PhD student.

Prior success of ICOM interns in our lab:
Summer 2021 ICOM intern in the Montrose lab was Spencer Hood. Mr. Hood conducted a literature review on environmentally induced sperm effects and gained hands-on skills related to DNA methylation quantification. He generated a very nice poster with his data which he presented in a lab meeting and later as part of a guest lecture in a Boise State course titled EOHS 437 Indoor and Outdoor Air Quality Management.


Alterations in Sperm DNA Methylation due to Particulate Matter Exposure
Spencer Hood, ICOM OMS-II; Luke Montrose PhD, Boise State; Adam Schuller, Boise State
BOISE STATE UNIVERSITY
Boise State & ICOM Collaborative Summer Research Internship
BACKGROUND
PARENT STUDY
METHODS
RESULTS
PYROGRAM
GLOBAL VALIDATION (IAP)
TARGETED VALIDATION
DNA METHYLATION CONTROL DESIGN
DISCUSSION/ CONCLUSIONS
REFERENCES

Location: Biomolecular Research Center (BRC)
PI: Julie Oxford, PhD, Jonathon Reeck, PhD

An opportunity for a student researcher to participate in translational wound healing research is available at the Biomolecular Research Center at Boise State University. A major challenge in the field of wound healing is the development products that stimulate formation and assembly of the extracellular matrix. This project aims to test a hydrogel formulation that accelerates skin healing while reducing the formation of scar tissue. Researchers participating in this project will gain hands-on experience investigating wound healing in the skin using 2-d and 3-d cellular and tissue model systems. This is an opportunity to participate in research focused on clinical application in wound healing. The student will work closely with the research team and participate in weekly research meetings.

- Principal Investors: Julie Oxford and Jonathon Reeck
- Duration: Flexible, but prefer 8-week part time, Start June 1st

Location: Biomolecular Research Center (BRC) Boise State University
PI: Shin Pu, PhD

Project 1. Effect of Doxorubicin on Cardiac Extracellular Matrix
Doxorubicin is a highly effective chemotherapeutic used to treat many adult and pediatric cancers, such as solid tumors, leukemia, lymphomas and breast cancer. However, its use is limited due to a dose dependent cardiotoxicity, which can lead to lethal cardiomyopathy. The major goals of this project are to elucidate whether doxorubicin adversely affect the function of cardiac fibroblasts which in turn disrupt the homeostasis of cardiac ECM and effects of doxorubicin on key fibrogenic signaling pathways in cardiac fibroblasts.

Project 2. Lipidomic Profiling of Autophagosome Membrane
Autophagy is a molecular machinery for "self-eating" in cells. It is a highly conserved process in response to extra or intracellular stress and signals such as starvation, growth factor deprivation, and pathogen infection. The objective of the proposed project is to elucidate lipid composition of autophagosome. We will use a Liquid Chromatography Mass Spectrometry based lipidomics approach to perform a comprehensive lipid profiling in mature autophagosome membrane.

Responsibilities for ICOM students: Conduct experiments, analyze data, prepare presentation and manuscript.
Skills required: Mammalian cell culture, protein extraction, protein detection using Western Blotting, gene expression measurement using Quantitative PCR (qPCR), microscopy imaging. We will train the student on these skills. The student will also have opportunities to learn confocal microscopy and mass spectrometry.
The time commitment: We expect the student to commit 20 hours / week for 8 weeks.

Location: Mechanical Adaptations Laboratory, Boise State University
PI: Anamaria G. Zavala PhD, Gunes Uzer PhD

The Uzer lab has a research opportunity for an intern to study how the DNA damage response is affected by mechanical challenges. The goal of this project is to develop a protocol to enhance repair and survival of healthy cells, while maintaining chemotherapeutic efficacy in cancer cells. We will be delving into the role of the Linker of Nucleoskeleton and Cytoskeleton (LINC) protein complex, which is downregulated in cancer cells, in mediating nucleotide excision repair of bulky DNA adducts, including UV and cisplatin damage.

An ICOM student will be mentored by Dr. Anamaria G. Zavala for their 5- or 8-week tenure, based on student availability. Research methodologies an intern will be exposed to include tissue culture, immunofluorescence microscopy, confocal microscopy, slot blot assays, qPCR, and immunoprecipitation. Dr. Zavala will guide the intern in the lab and help develop critical thinking skills to determine the next steps to reach the desired research goal. In addition, the ICOM student will have the opportunity to attend and present at a biweekly lab meeting.

Funding will help buy necessary supplies including antibodies, microscopy dishes, tissue culture media, and recharge time for the confocal core.