Internship Opportunities for ICOM students, Summer 2023
Boise State University

Membrane Biophysics Lab

PI: Daniel Fologea, PhD

1. Liposomes as functionalized nano-carriers for tumor targeting and controlled 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 functionalization will be carried out with folic acid (folate receptors are abundant on the surface of more than 90% of cancer cells) and aptamers targeting cancer-specific surface biomarkers. In addition, the composition of the membrane and the aqueous interior will be adjusted to enable controlled release of the loaded drugs by mild hyperthermia, radiation, external electric fields, mechanical, 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 bioconjugation techniques, 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. To complete this project, $1,500 funding is needed for the purchase of specialty lipids, drugs, and aptamers.

Laboratory for Inflammatory Cytokines in Tumor Invasion and Metastasis

PI: Cheryl Jorcyk, PhD

The Jorcyk Lab at Boise State University conducts basic, translational, and clinical research on the role of inflammatory proteins in tumor invasion and metastasis. Dr. Cheryl Jorcyk is a Professor in the Department of Biological Sciences and the Biomolecular Sciences Graduate Program and is the Director of Clinical & Translational Research at Boise State. Her lab's research focuses primarily on the function of interleukin-6 (IL-6)-like cytokines in breast and prostate cancer. Currently, there are five graduate students and numerous undergraduate students working in the lab. Previously, we have had medical student interns from the University of Washington, Seattle, the University of Washington, WWAMI, the Pacific NW University of Health Sciences, and ICOM.

We are seeking a summer intern student to participate in our:

1) Interdisciplinary drug development program. Our lab partners with organic chemists, structural biochemists, and in silico modelers to develop and test novel small molecule inhibitors (SMIs) against inflammatory cytokines. The Jorcyk lab is responsible for testing the potential drugs in vitro and in vivo.

2) Bioinformatic analysis of patient data. Our lab uses existing data bases and partners with biostatisticians to study the effect of inflammatory cytokine signaling on cancer subtypes, cancer progression, disease-free survival, and overall survival. We plan to start new studies on the disparities associated with inflammatory cytokines in tumor invasion and metastasis.

Northwest Tissue Mechanics Laboratory

PI: Trevor Lujan, PhD

Project Description: The repetitive wear-and-tear of joint structures plays a significant role in chronic joint pain and disability, yet little is understood about the mechanical factors that drive this insidious degenerative process. The NTM lab plans to investigate the mechanical origins of joint degeneration by testing whole knee joints in a state-of-the-art robotic joint simulator and measuring wear and damage to the meniscal tissue.

Project Needs: This project would greatly benefit from having the support of an ICOM student who can assist our lab in designing an upcoming series of experiments to apply physiological loads to the knee joint that are representative of activities of daily living and exercise. Tasks for the ICOM student include: literature surveys, dissection, assisting fixture design and mechanical testing, and interpretation of results. Funding would be used to cover costs to operate the instruments, acquire joint specimens, and cover costs for test materials and supplies.

Mentorship: The ICOM student would be working directly with a third year Ph.D. student, Kate Benfield, who is leading efforts on this experiment for her doctoral dissertation. Kate will meet on a daily basis with the ICOM student, and the lab director, Trevor Lujan, will meet at least once a week with the ICOM student. The NTM lab has a strong publication record, and this project will result in the ICOM student being a co-author on a peer-reviewed conference proceedings and an original journal article.

Tinker Laboratory

PI: Juliette Tinker, PhD

Project:
Salmonellosis is one of the most commonly reported foodborne illnesses in the U.S. This bacterial infection in humans results in significant morbidity and high rates of hospitalization, with estimates of healthcare costs as high as $4 billion per year. Salmonella can be transmitted from beef and dairy products and negatively impacts the health and welfare of cows, as well as the economics of the industries that depend on them. Despite increased awareness and improved sanitation, the incidence of foodborne Salmonella has not declined, and strains have become more antibiotic-resistant. An effective vaccine to prevent infection with non-typhoidal Salmonella, or NTS, in beef and dairy cows would reduce transmission to humans and improve animal health. Bacterial AB5 toxins are well-known components of vaccines that can act as both protective antigens and stimulators of immunity. S. Typhimurium produces a known AB5 toxin, and we hypothesize that there are more that are conserved and widespread in bovine Salmonella. Our long-term goal is to develop an effective oral vaccine to prevent salmonellosis in dairy and beef cattle. During this internship, a student will use a bioinformatic approach to determine the prevalence and conservation of the receptor, or B5, subunits and will assess the immunostimulatory and antigen-delivery activity of these proteins in cell culture. These studies will provide key evidence to support future Salmonella vaccine protective efficacy trials in cows.

Skills that will be acquired: The student will learn computational methods to search Salmonella whole genome sequences using NCBI Genome, Pathogen Detection and PATRIC to find B5 sequences similar to known Salmonella B5 toxins. These methods will also include building a B5 consensus based on structural modeling and domain conservation. The student will also learn cloning, protein expression, protein purification, tissue culture, microscopy and quantitative RT-PCR to purify a Salmonella toxin B5 protein and characterize its activity on epithelial cell culture in vitro. All work will be pre-approved by the Institutional Biosafety Committee.

Funding needed for this project: Funds will be needed for supplies to support bacterial growth, cloning, protein purification, tissue culture growth and microscopy, and quantitative RT-PCR.

Mechanical Adaptations Laboratory

PI: Anamaria Zavala, 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. The long-term goal of this research is to develop passive mechanical stimulation as a means to reduce the debilitating side effects of chemotherapeutic regimens.
The ICOM student will be mentored by Dr. Anamaria G. Zavala for their 5- or 8-week tenure, based on student availability. The intern will be trained in methodologies including 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 BMMB confocal core.