VAS Fall Undergraduate Research Meeting Awardees

November 7, 2020

Hampden-Sydney College - Virtual/Online Symposium

Undergraduate Research Grant Recipients

A-4 Development of computational models of prodrugs bound to nitroreductase enzymes

Madeline Clark

Mentor: Tobb Gruber, Dept. of Molecular Biology & Chemistry, Christopher Newport University

Gene-Directed Enzyme Prodrug Therapy (GDEPT) is a new approach to cancer therapy which relies on the delivery and expression of exogenous enzymes in tumor cells, followed by administration of a prodrug which will be activated into a cytotoxic form only in tumor cells. Research into possible enzyme/prodrug pairings (through docking simulations and enzyme kinetics assays) is necessary for improving efficacy.

B-4 The influence of naturalistic social stress on the gut microbiome in mice: Relevance in human psychopathology

Sophie Dixon

Mentors: Parrish Waters and Swati Agrawal, Dept. of Biological Sciences, University of Mary Washington

The gut microbiome influences physiological and psychological health. As well, social subordination is a potent stressor that can result in psychopathology in humans, and disease in animals. We will keep colonies of laboratory mice and determine their social rank to assess the effects of naturalistic social subordination on the gut microbiome in these animals.

C-3 Determining gene flow between bald cypress and pond cypress

Joshua Sprouse

Mentor: Edgar Lickey, Dept. of Biology, Bridgewater College

We will extract and amplify the cpDNA trnC-ycf6 intergenic spacer region from saplings grown from seeds of 2 parent pondcypress (*Taxodium ascendens*) and 2 parent bald cypress (*Taxodium distichum*) from two populations in North Carolina. To determine if gene flow is present between the taxa, the presence or absence of a unique restriction site found in pond cypress will be determined.

C-4 Groundwater well monitoring and analysis in urban wetlands
Benjamin Heskett
Mentor: Laura Henry-Stone, Dept. of Environmental Sciences, Studies, & Sustainability, University of Lynchburg

Through groundwater well installation and monitoring, this research will provide a hydrological analysis of a small urban watershed in Lynchburg, Virginia. The analysis will help inform a project being designed by the City of Lynchburg and University of Lynchburg to remove a high hazard dam, restore Blackwater Creek, and enhance the surrounding floodplain wetlands.

D-1 Molecular basis of deficient immunity triggered by the adaptor protein Tom1
Neha Reddy
Mentor: Daniel Capelluto, Dept. of Biological Sciences, Virginia Tech

This project will employ various binding assays and biophysical techniques to characterize the functional and structural properties of the naturally occurring mutation G307D in the adaptor protein TOM1 to better understand the molecular basis of autoimmunity and immune deficiency triggered in patients with this mutation.

D-4 Developing a BSL1 titan cell model for cell cycle studies
Mary Richfield
Mentor: Michael Price, Dept. of Biology & Chemistry, Liberty University

This project will expound upon previous research on the virulence trait of titan cell formation within the *Cryptococcacae* family. Specifically, I will investigate whether titan cell formation can be observed in nonpathogenic strains in *Cryptococcacae*. Titan cells have a unique cell cycle that could be studied to better understand cancerous cell cycles.

E-5 Optimizing a biosensor-based assay for ubiquitination activation
Roma Broadberry
Mentor: Christopher Berndsen, Dept. of Chemistry & Biochemistry, James Madison University

We are employing an ATP fluorescent biosensor to measure the enzyme activity of ubiquitination. Our goal is to optimize this fluorescence-based activity assay for continuous monitoring of ubiquitination activation by enzyme Ub-E1. The fluorescent sensor is ATP-dependent; thus, the approach is to measure ATP hydrolysis based upon continual E1. The fluorescent sensor is ATP-dependent; thus, the approach is to measure ATP hydrolysis based upon continual fluorescence loss in solution with ubiquitin and activating enzyme E1.

F-2 Enhancing efficacy of norcantharidin in target cells by direct coupling to aptamer

Shannon Fehr and Lauren Western

Mentor: Lindsey Stevenson, Dept. of Biology & Chemistry, Liberty University

This project will attempt to increase the effectiveness of NCTD as an anti-cancer drug by using a chemically bound aptamer to target cell death to cancer cells. This will potentially allow the drug to bind only to cancerous cells will allowing the uninterrupted proliferation of healthy cells.

G-3 Biochemical characterization of a putative glutamate-2,3-aminomutase in methanogenic *Archaea*

Taylan Tunckanat

Mentor: Kylie Allen, Dept. of Biochemistry, Virginia Tech

Methanogens are ancient organisms capable of surviving in extreme conditions. In high salinity, they synthesize and accumulate osmolytes to prevent the dehydration of the cell. Although beta-glutamate is a common osmolyte, a glutamate-2,3-aminomutase required for its synthesis has not been studied before. Here, we propose a gene encoding a methanogenic glutamate-2,3-aminomutase and aim to biochemically characterize it *in vitro*.

Honorable Mention

A-3 Transfer deep learning for estimating bat flight kinematics

Sounak Chakrabarti and Hannah Thielman

Mentor: Rolf Mueller, Dept. of Mechanical Engineering, Virginia Tech

The proposed research is aimed at the design and implementation of a flight tunnel instrumented with an array of 50 high-speed video cameras for capturing bats in flight. This image data, obtained from multiple vantage points, will be used to train a deep neural network which will ultimately make a kinematic model based upon bat flight.

D-3 Analysis of the effects of the protein survivin on histone H3 in metastatic breast cancer

Emma Strouse

Mentor: Allison Jablonski, Dept. of Biology, University of Lynchburg

Survivin is an inhibitor of apoptosis (IAP) protein known to be produced in high levels in cancerous cells. Using a breast cancer cell model, this project examines effects of the protein survivin on histone H3, potentially playing a role in epigenetics because of its interaction with the N-terminal tail of histone H3.

F-4 Characterization of the apoptosis pathways in kinetoplastids using *Crithidia fasciculata* as a model organism

Kaelynn Parker and Clayton Parker

Mentor: Swati Agarwal, Dept. of Biological Sciences, University of Mary Washington

Apoptosis is a poorly characterized process in kinetoplastids. This project will study this intricate molecular pathway using RT-qPCR to determine which genes are differentially regulated in apoptosis in *C. fasciculata* from genes identified through gene ontology. A CRISPR-Cas9 protocol for *C. fasciculata* will be developed and used for tagging and knockout studies to further determine apoptosis gene candidates' function.

G-2 Bioinformatic comparison of 1979 Sverdlovsk and 2016 Yamal Peninsula *Bacillus anthracis* strains via whole genome sequence and single-nucleotide polymorphism analysis

Rachel Craig

Mentor: Gary Isaacs, Dept. of Biology & Chemistry, Liberty University

This research project seeks to compare the pathologies and sequences of two *Bacillus anthracis* (anthrax) samples located in Russia in 1979 and 2016 to determine the genetic correlation between them. pXO1 and pXO2 plasmids (the two plasmids that make anthrax virulent) will be analyzed based on single nucleotide polymorphisms (SNPs) utilizing Bioconductor tools on R.

G-4 Identification of interacting proteins with zinc finger protein 410

Mariko Locke, Feifan Xu and Moriah Payne

Mentor: Gary Isaacs, Dept. of Biology & Chemistry, Liberty University

This project is seeking to identify isolated protein bands from co-immunoprecipitation experiments that are believed to be interacting proteins of zinc finger protein 410 (ZFP410) using mass spectrometry. These findings may assist in determining the role of ZFP410 in the brain and might describe the molecular pathways involved in cognition and learning.