John S. Rogers Program

2022
Summer Science Research Poster Conference

Tuesday, September 13
4:30 – 6:00 pm
Smith Hall

John S. Rogers Science Research Program

This program prepares outstanding students for careers in the sciences by supporting collaborative scientific research between students and faculty. In addition, the program aims to attract and retain outstanding students and faculty in the mathematical and natural sciences. Rogers fellows are trained not only as scientists, but as scientists who have a responsibility *to communicate the purpose and results of their work to a general audience.*

The following pages contain summaries of the research projects conducted during the summer of 2022. In these abstracts and in the conference posters, the names of the student researchers are followed by their expected year of graduation; the project director's name is listed last. To get the most out of the conference, ask the student presenters to explain to you the essence and significance of their research projects.

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Functional Trait Variation Between and Within Vascular Plant Species. Elizabeth Cook '24, Christopher Olson '23, Randall Long, *Department of Biology, Lewis & Clark College*.

Traits reflect an organism's ability to respond to their environment, and there is variation in traits at both the individual and species levels. We conducted two observational studies investigating trait variation across species in the same location, as well as in the same species across broad environmental gradients. To look at interspecific differences, we worked with the Trait Diversity Network (TDN), which uses a standardized sampling protocol across the globe to examine correlations between above and below ground plant traits. In contrast to this study, we are taking similar measurements on a set of conifer species across different environments in Oregon and Northern California. These locations vary in aridity, and we aim to observe if variation in traits is correlated with climate.

As part of the TDN, we conducted an observational study of vascular plant species in a 10m x 10m plot on the Lewis & Clark campus. We measured species abundance, percent ground cover, plant height, and took samples to measure Specific Leaf Area (SLA). SLA is the ratio of the area of a leaf to dry weight and was the primary trait of interest to us in both studies. SLA is often used as a proxy for investment where thinner (or "cheap") leaves generally have a higher SLA in comparison to thicker leaves (or more "expensive") leaves. Theory predicts that SLA and height should be correlated in annual plants, however we found no correlation between them in our TDN samples. We hypothesize that this is a result of most of the species surveyed being understory plants and majority shaded species, or a tradeoff with an unmeasured trait. We are continuing to measure and analyze other traits, such as seed production, to further explain this lack of correlation. We also are testing whether there is a correlation between leaf traits in conifers and climate.

Generating IFN-gR Knockout Pancreatic Tumor Cell Clones for CD4T Cell Studies
Maryam Al-Ghezi[1,4], Margaret Haerr[2,3], Kyle Gribbin[2], Dr. Katelyn T. Byrne[2,4]
CDCB summer internship program[1], Department of Cell, Development & Cancer Biology[2], OHSU Graduate Program in Biomedical Science[3], OHSU Brenden-Colson Center for Pancreatic Care[4].

Interferon -gamma (IFN-g) is a pleiotropic cytokine that plays an important role in tumor cell growth. It promotes MHC I expression for CD8 Tcell rejection. In H-2K^b null tumors, CD4 Tcells induced by CD40/ICB drive tumor rejection, but IFN-gR expression is required on host cells. To test the requirement for IFN-gR on tumor cells, we generated IFN-gR knockout Pancreatic tumor cell lines. We confirmed insensitivity to IFN-gR stimulation in vitro, and have ablated IFN-gR expression in H-2K^b null tumor cell lines. Analysis of IFN-gR-H-2K^b double knockout cell lines is ongoing. These data will reveal potentially novel mechanisms of CD4 Tcell mediated tumor rejection.

Identifying a novel gene involved in LRO biogenesis in *C. elegans*
Frances Courtemanche '24
Department of Biochemistry and Molecular Biology, Lewis & Clark College

Lysosome-Related Organelles (LROs) are a category of organelles that have distinct functions, morphologies, and contents depending on the type of cell they are present in. LROs are formed through the endocytic trafficking pathway. *Caenorhabditis elegans* are transparent nematodes that have LROs called gut granules in their intestinal cells. Gut granules in *C. elegans* contain optically active birefringent and autofluorescent material which allows for them to be observed live in living specimens. Currently, we know of 33 genes that function in gut granule biogenesis, many of which do so by coding for protein complexes present in the endocytic trafficking pathway. We have identified another gene, called *acdh-11* which also plays a role in LRO biogenesis. *Acdh-11* was first identified in a paper by Dengke et al. 2015 which found that the *acdh-11* gene plays a role in heat adaptation. They studied a strain of worms with a mutation in the *acdh-11* gene. Through a series of experiments, we found that the same mutation in *acdh-11* also causes an enlargement in gut granules. After identifying that a mutation in *acdh-11* was responsible for the enlarged gut granules, we studied the *acdh-11* heat adaptation pathway identified in the paper to see if the same pathway was responsible for the observed gut granule enlargement. We found that it was. Further research is required to understand what specific gene/protein in the pathway is causing this enlargement.

Investigating Lysosome-Related Organelle Biogenesis During *Caenorhabditis elegans* Embryonic Development. Madeline Daniel '24, Greg Hermann, *Department of Biology, Lewis & Clark College*.

Lysosome-Related Organelles (LROs) are a group of cell type-specific compartments that share features with, but are distinct from, lysosomes and endosomes. LROs function in a wide variety of biological processes and are found in many different organisms. The intestinal cells of the nematode *Caenorhabditis elegans* have a unique LRO called gut granules, which contain optically-active material that make the structure easy to visualize. These birefringent and autofluorescent properties of gut granules first become visible in mature embryos, but it is otherwise unclear how LROs are formed within the context of embryogenesis. In order to better understand LRO formation, I have been using indirect immunofluorescence to investigate the biogenesis of gut granules in early *C. elegans* embryos. Immunofluorescent staining and confocal imaging of 1-, 2-, and 4-cell embryos suggests that LROs are not passed on from the oocyte and are instead formed later in embryogenesis. To try and identify the initial formation of LROs in the embryo, I am using similar immunofluorescent techniques with E4 embryos, which are slightly more mature and are beginning to form the intestinal primordium. Preliminary results suggest that the E4 embryonic stage is an important and dynamic period for LRO biogenesis. As the project progresses, I plan to use more immunofluorescence and confocal imaging to be able to construct a detailed, visual timeline of LRO formation throughout embryogenesis.

The Underlying Causes of Parkinson's Disease: Is Alpha-Synuclein A DNA Repair Protein? Celeste Jongeneelen '23, Nicole Brockway, Tamily Weissman-Unni, *Department of Biology, Lewis & Clark College*.

Parkinson's Disease is a progressive neurodegenerative disease which affects movement and impacts approximately one percent of the population over the age of sixty. One main pathological hallmark of Parkinson's Disease is the abnormal aggregation of alpha-synuclein protein into larger masses in the cytoplasm called Lewy Bodies. While Lewy Bodies are present within neurons in Parkinson's Disease patients, the direct effect they have on cells remains unclear. A recently emerging hypothesis in the field is that one function of alpha-synuclein is to modulate normal DNA repair in the nucleus, and that the Lewy Bodies sequester alpha-synuclein in the cytoplasm, decrease DNA repair, and as a result cause accumulation of DNA damage. This could ultimately lead to cell death and the observed clinical symptoms.

To test this hypothesis in our lab, we use zebrafish as a model organism and can express exogenous DNA by microinjection techniques. We use a fluorescence reporter approach to quantify DNA repair in different alpha-synuclein conditions. This summer we primarily focused on the first step of this work, which is to complete a thorough analysis of overlapping cell populations when zebrafish embryos are co-injected with two DNA plasmids. Embryos were first co-injected with DNA plasmids that tag the nucleus with two different fluorescent proteins (green and red), imaged, and then analyzed for colocalization.

Regeneration and Diversity in an Old Growth Pacific Northwest Forest. Gabriela Kuglen-Alvarez '24, Isaac Ison '24, Helen Andino '24, Margaret Metz, *Department of Biology, Lewis & Clark College*.

We have conducted a study on the factors that play a role in conifer seedling survival to understand forest change and persistence at the Wind River Experimental Forest. Our research quantified seed production, germination rates, and seedling survival and growth rates for trees at Wind River. We measured vegetation coverage and diversity, moss cover, and nurse log presence in established 1x1 meter plots and accompanying seed traps that were distributed every 40 meters throughout the 27.2 hectare study area. Examining these data can be used to understand how these factors affect both new germinants and established seedlings of different conifer species. The data collected will then be contributed to the Forest Global Earth Observatory, a database of 59 different forests across 27 different countries, allowing for comparison and understanding of global trends amid our dramatically changing climate.

Elevated temperatures reduce larval survival but enhance settlement in *Cassiopea*. Sammy Kutsch '24[1], Megan Maloney[2], Marie Strader[3]. [1]*Department of Biology, Lewis and Clark College,* [2]*Auburn University,* [3]*Texas A&M University*

Increasing ocean temperatures pose a significant threat to many marine invertebrates. However, *Cassiopea* adults are robust to high temperatures, possibly facilitating recent population expansions. Early life-history stages are thought to be more sensitive to environmental change, but it is unknown if this is true for thermally robust species such as *Cassiopea*. Additionally, *Cassiopea* adults exhibit a wide variety of coloration, which has anecdotally been associated with increased thermal tolerance. We characterized the effects of elevated temperatures on larval survival and settlement rates of *Cassiopea*, and if offspring from parental color morphs fared differently in elevated temperature conditions. Larvae in elevated temperatures (32°C) had higher settlement rates but reduced survival over time than larvae in ambient temperatures (26°C). Coloration of parents was not found to have a significant effect on settlement or larval survival. This suggests that any thermal tolerance associated with adult coloration is not transmittable to early life-history stages in the subsequent generation. These results show a complex perspective of elevated temperature on *Cassiopea* early life-history stages - developmental progress is enhanced in higher temperatures, in tandem with selection on larval thermal tolerance. This could imply that some marine invertebrates are capable of acclimating to warming induced by climate change.

Examining OCT4/SOX2 Binding in the *Klf4* Gene. Savannah C. Myers '23, Dr. Sharon E. Torigoe, *Department of Biology, Lewis & Clark College*.

Transcription is the critical first step in the process of gene expression and understanding how transcription is regulated provides valuable insight into the function and activity of genes. One important mechanism of transcriptional regulation is the binding of transcription factors to their binding sites to control the process. For the gene *Klf4,* the transcription factors OCT4 and SOX2 are necessary for gene expression. However, the binding sites located in the three enhancers of *Klf4*—called E1, E2, and E3—show lower binding affinity for the OCT4-SOX2 dimer compared to the consensus sequence. I conducted electrophoretic mobility shift assays (EMSAs) to investigate individual binding of OCT4 and SOX2 to the E1, E2, and E3 binding sites to examine their binding without the synergistic component. I demonstrate that individual OCT4 or SOX2 binding at each enhancer is lower than individual binding at the high affinity OCT4/SOX2 binding site OS-*Nanog*, except in the case of OCT4 binding to E1, which has higher binding, which was unexpected based on predictive tools and past data concerning the OCT4-SOX2 dimer. These results reveal that, despite how critical OCT4/SOX2 binding is for transcription, much of how OCT4 and SOX2 engage with DNA is still not fully understood. Understanding how OCT4 and SOX2 interact with DNA is critical for understanding the important roles of transcription factors and their binding sequences in gene expression and transcription regulation.

Investigating the mechanisms for gut granule number consistency during late embryonic development in *Caenorhabditis elegans*. Yoona Shim '23, Greg Hermann, *Department of Biology, Lewis & Clark College*.

Lysosome-related organelles (LROs) are cell-type specific organelles that have unique morphologies and functions. *Caenorhabditis elegans*, a species of nematodes, have LROs that are called gut granules, which are present in the intestinal cells. Gut granules are known to be formed during embryonic development. However, prior research has revealed that the number of gut granules stays constant from the time that the embryo has formed 8 intestinal cells until the time that it hatches. There are two likely possibilities that we have hypothesized. The first is that gut granules are formed and lost at the same rate. The second is that all gut granules are formed in one initial wave of biogenesis. To investigate, I looked at a genetically modified strain of *C. elegans* in which a gene essential for the biogenesis pathway is turned off. The gene is programmed for transcription at a certain stage of embryonic development. I observed several known markers for gut granules, including optically active birefringent material and autofluorescent material as well as proteins which localize to gut granules. I also used another genetically modified strain where the same gene is turned off and it is programmed for transcription when the organism is heat shocked. I observed known gut granule markers for this strain as well. Thus far, some markers are rescued while others are not, prompting further research into the mechanisms behind these phenomena. Studying the timing of the appearance of gut granule markers can help us to understand the mechanisms of the biogenesis pathway of LROs in *C. elegans* and other organisms, including humans.

Investigating the role of dynein in the asymmetric positioning of organelles in *Caenorhabditis elegans* intestinal cells. Rose Thompson '23, Greg Hermann, *Department of Biology, Lewis & Clark College*.

During embryonic development, the surface and cytoplasm of intestinal cells in *C. elegans* become polarized, segregating into distinct apical, lateral and basal domains. Organelles in the conventional endolysosomal pathway segregate apically while gut granules, a kind of lysosome-related organelle unique to *C. elegans,* segregate basally. The mechanisms underlying this polarization have not been explored. Understanding such mechanisms may offer insight into the function of a polarized cytoplasm in both *C. elegans* and humans. I used a genetically modified strain of *C. elegans* responsive to the plant hormone auxin to selectively deplete the function of the motor protein dynein in *C. elegans* embryos and fluorescent markers for organelles in the endolysosomal pathway to test if dynein was necessary for the apical positioning of these organelles. After dynein depletion I found that RAB-5 signal, which marks early endosomes, and LAAT-1 signal, which marks lysosomes, both moved away from the apical surface of the intestinal cell. This suggests that dynein is necessary for the apical positioning of these organelles. My upcoming work will explore the role of dynein in the apical positioning of late endosomes using a RAB-7 marker and test potential kinesin motor proteins that could also play a role in organelle positioning.

Using CRISPR-Cas9 Genome Editing to Substitute a High-Affinity TF Binding Site. Jack Waite '23, Dr. Sharon Torigoe, *Department of Biochemistry and Molecular Biology*, *Lewis & Clark College*.

Enhancers are non-coding regions of DNA bound by transcription factors (TFs) that activate expression of developmental genes. Understanding how enhancer sequences code for gene expression patterns will be crucial in revealing how cellular differentiation and development is achieved. As a model, *Klf4* is a gene that helps define the identity of mouse embryonic stem cells (mESCs) and is regulated by three enhancers. Enhancer 2 (E2) contains a low-affinity binding site for OCT4-SOX2 that plays a central role in enhancer function. Substitution with a high-affinity site greatly increases gene expression in reporter assays, pointing to the functional role of low-affinity sites. However, reporter assays have limitations in that they do not fully replicate endogenous transcription regulation. Therefore, the high-affinity site must be tested in its native genomic context.

To test the effect of a high-affinity OCT4-SOX2 site on *Klf4* expression, I used CRISPR-Cas9 to generate a mESC cell line carrying the mutation in the genome. Cells were transfected with YFP and the Cas9 protein, inducing DNA cleavage at E2 and initiating repair pathways that introduced the high-affinity binding site. To isolate cells that were successfully transfected, cells were sorted based on expression of YFP. To identify clones with the mutation, qPCR was performed to measure WT and mutant alleles, followed by sequencing. Three clonal populations were generated carrying the high-affinity OCT4-SOX2 site. I plan to analyze the effect of this mutation on *Klf4* expression during the fall semester.

Investigating coordination among clonally related cells in the developing zebrafish brain. Gila Winefeld '23, Nicole L. Brockway, Tamily A. Weissman, *Department of Biology, Lewis & Clark College*.

During vertebrate embryonic development, asymmetrically dividing neural stem cells known as radial glia line the cerebral ventricles and produce most of the excitatory neurons that come to populate the central nervous system. Each radial glial cell produces a cluster of daughter neurons; each cluster together with the radial glial mother cell is known as a clone. It is unclear what role, if any, the clonal relationship plays in the complex development of the brain. One possibility is that clonally related cells preferentially communicate and coordinate with one another. Two potential kinds of coordination that might exist within clones are synchronized cellular activity and/or direct cytoplasmic communication, specifically through gap junction coupling. I am working on testing these hypotheses using calcium imaging and dye fill approaches as well as Brainbow, a multicolor cell-labeling technique our lab uses to visualize and study neuronal lineage in the living zebrafish brain.

Struvite precipitation from synthetic Hydrolyzed Urine using a Mg Metal-Air Fuel Cell. Makena Andersen '24, Kelsey Stoerzinger, *College of Chemical, Biological, and Environmental Engineering, Oregon State University*.

Electrochemical processes can drive pH changes and metal dissolution, leading to precipitation of minerals containing key nutrients (P,N) for plant growth from waste streams. Struvite ($MgNH_4PO_4 \cdot 6H_2O$), a white, crystalline, poorly soluble slow release fertilizer, can be precipitated using Mg metal-air fuel cell (MAFC) with synthetic urine as the electrolyte. An MAFC provides an effective, less expensive, and more sustainable way to precipitate struvite and recover P, a limited resource required for plant growth, at higher efficiencies than traditional struvite precipitation methods. The anodic oxidation of Mg to Mg^{2+} provides a source of Mg cations, the use of a gas diffusion layer (GDL) provides the OH^-, and the synthetic urine provides the N and P required to form struvite. This research shows that the storage time after electrochemically-induced precipitation in an MAFC can have a positive effect on total struvite precipitation and subsequent P recovery. This provides new strategies to reduce the amount of charge used in precipitation, creating an overall more efficient process.

Mutivalent LC8 Binding in the ASCIZ Transcription Factor. Alyssa Abe '23, Logan Hausler '25, Madeline Kramer (HS '23), Nikolaus Loening, *Biochemistry & Molecular Biology Program, Lewis & Clark College*.

We conducted experiments on dynein light chain 8 (LC8) and measured its binding affinity for a number of sites in the intrinsically disordered region of its transcription factor, ASCIZ. LC8 is a ubiquitous hub protein that is involved in numerous cell processes and is a binding partner for over 100 different proteins. For our experiment, we used previously generated ASCIZ mutants with between one and three binding sites, allowing us to study binding to individual sites as well as in cooperation with neighboring sites. To quantify the binding strength, we used recombinant protein expression to generate protein samples, purified proteins using several chromatography steps, and then used isothermal titration calorimetry (ITC) to measure the enthalpy of binding, binding stoichiometries, and dissociation constants. For most samples, the expected binding stoichiometries were observed but results for some mutants hint that one of the binding sites might be positioned at a different location than predicted. Our results will help in understanding the relationship between the amount of LC8 binding sites and ASCIZ transcription factor activity.

Fundamental Studies on Organosulfur Oxidation for Environmental Remediation by Oxodiperoxo Molybdenum Catalysts. Owen Beale ’24, Mia Bell ’24, Louis Kuo, *Department of Chemistry, Lewis & Clark College*.

Sulfide oxidation is key in the desulfurization of transportation petroleum products. This research focused on the oxidation of thiophene and phenyl trifluoromethyl sulfide using a variety of molybdenum(VI) oxodiperoxo catalysts. Reactions were generally performed in water under mild conditions (50 °C). Results were tracked using ^{1}H and F^{19} nuclear magnetic resonance (NMR) and gas chromatography-mass spectrometry (GC/MS). The successful oxidation of thiophene was achieved, but side reactions led to large amounts of unpredicted brominated products. Oxidizing 2,5-dimethylthiophene and altering the synthesis of the catalyst resulted in less bromine contamination. Reacting the oxodiperoxo molybdenum catalyst with phenyl trifluoromethyl sulfide resulted in the near complete oxidation of the starting material into phenyl trifluoromethyl sulfone. Kinetics of the reaction yielded an Arrhenius plot and an activation energy.

Making Moves: Elucidating the Binding Region of the Dynein IC-2C and Dynactin p150^{Glued} Interaction. AJ Di Nicola ‘24, Jake Ancheta, Nikolaus M. Loening, *Biochemistry and Molecular Biology Program, Lewis & Clark College*.

Dynein is a multi-subunit motor protein integral to the transport of molecular cargo throughout the cell. In mammals, dynein only exhibits movement when interacting with dynactin, another protein. This interaction is regulated through the binding of the intrinsically disordered dynein intermediate chain (IC) with the dynactin subunit p150^{Glued}. Specifically, the single alpha helix (SAH) region of dynein IC (residues 1-44) interacts with the coiled-coil 1B (CC1B) region of p150^{Glued} (residues 358-555). However, previous research has only been able to narrow down the CC1B residues that directly interact with IC to 382-531. To help further narrow down which residues of CC1B play a significant role in dynein-dynactin binding, we used nuclear magnetic resonance (NMR) spectroscopy to measure the intermolecular paramagnetic relaxation enhancements (PREs) of ^{15}N-labeled IC-2C when interacting with paramagnetically-tagged p150^{Glued} CC1B. Preliminary PRE NMR results suggest that the IC binding site on CC1B is close to residue 434.

Polarization Induced Alcohol Adsorption Using Electrified Interfaces

Drew Blauth '23[1], Sevan Menachekanian[2], Jahan Dawlaty[2]
[1]*Department of Chemistry, Lewis & Clark College*
[2]*Dornsife Department of Chemistry, University of Southern California*

Molecules bound to solid surfaces exhibit different properties than those dissolved in solution, enabling scientists to perform reactions using adsorbed molecules following different procedures than traditional solution-based reactions. One important example of this is alcohol oxidation, which plays a crucial role in a wide variety of applications such as battery design. This project explored alcohol adsorption onto gold by testing two nearly identical alcohols, which only differ by one alcohol having an additional carbon. This made it possible to investigate both the oxygen's interactions with gold and if the additional carbon influenced adsorption.

Surface Enhanced Raman Spectroscopy (SERS) was used to identify that the alcohols were capable of adsorbing onto gold. Following this discovery, both alcohols were adsorbed onto gold electrodes and electrified via applying potential across the electrodes in electrochemical cells. Following data collection and analysis with SERS and MatLab, respectively, it was clear that the alcohols changed how they interacted with the gold based upon the applied potential. This suggests that alcohol adsorption, and therefore oxidation, may be possible to control by electrifying alcohols adsorbed to gold surfaces. In addition, the two alcohols exhibited very different behavior relative to one another, implying that the additional carbon in the larger molecule influenced adsorption. Future research will focus on testing similar alcohols and the mechanisms underlying these gold-alcohol interactions.

Predicting Student Success in Cyber Security Exercises using Machine Learning. Nic Richardson ‘23, Wyeth Greenlaw Rollins ‘24, Jens Mache, *Department of Mathematical Sciences, Lewis & Clark College*.

As Machine Learning continues to be capable of meeting the challenges raised by various disciplines, we seek to apply it to computer science education. Specifically, our focus is on aiding student-instructor interactions by helping instructors give timely feedback to students during hands-on activities. In such activities, both large class sizes and students who are unwilling to ask for help can limit student-instructor interaction and prevent student success. Therefore, we aim to help instructors meet these challenges with a system that will deliver hints to struggling students during these exercises.

Our system is a component of EDURange; a platform hosting a collection of hands-on cyber security exercises. The core of our system depends on a machine learning model that can predict whether or not a student will complete an exercise. These predictions are made based on how students interact with the activity environment. Through early experiments with different pattern mining and machine learning techniques, we succeeded in predicting exercise completion with accuracies between 60-80%. As this research continues, we plan to improve the accuracy of our prediction model with continued data collection as well as experimentation with new machine learning techniques.

Dependable Computing. Michael Harper ‘23, Caitlyn Wilde ‘25, Christian Ermann ‘22, Alain Kägi, Jens Mache, *Department of Mathematical Sciences, Lewis and Clark College*.

Not a day goes by that we do not hear about a new cybersecurity incident. Writing provably correct code would alleviate this concern, but it is a neglected area of investigation. As a proof of concept we are building a networked temperature sensor. Such sensors could be deployed to monitor incubators in a biology laboratory.

We are developing this sensor on top of a single-board computer. Its software is written in the C programming language and the plan is to prove the correctness of this program’s implementation against a formal specification. At this time, we have completed many components of the networking stack and we have started the proof of one of them.

Rehearsing Disaster: Understanding earthquake preparedness behavior in an interactive environment

Assistant Researchers: Evan Eldridge, Ahmed Esmali, Sylvia Kunz, Miri Rinehart, Skye Russ, & Sarah Wood
Principal Investigators: Liz Safran, Peter Drake, Bryan Sebok, & Erik Nilsen

Abstract

Situated inland the Cascadia Subduction Zone, the Pacific Northwest will experience an M8 or M9 earthquake in the future. Given the current state of earthquake infrastructure and disaster education, this event is expected to cause thousands of casualties and economic havoc. Despite the serious risk of such a disaster, many PNW residents, especially 18-29 year-olds, remain uninformed and unprepared. Our first experiment suggests that video games can be more engaging than relevant web content and similarly effective at moving young adults toward earthquake preparedness. The current study explores player identification with in-game location and living circumstances among 240 participants, half from the Portland Metro Area and the other from metropolitan areas west of the Cascades. Our game is set in Portland, Oregon with popular landmarks. We hypothesize that those who live in Portland will be more impacted by the game than those who live elsewhere. There are two versions of the game, one where the player lives in a house and the other with the player living in a multi-unit apartment with less storage. We hypothesize that participants will benefit most from playing the game that matches their dwelling type. Once players secure clean water and a bodily waste solution, they can complete the game successfully or collect additional points while helping non-player characters by trading items. Pre- and post-tests will assess learning, self-efficacy, outcome expectations, and intent to act relative to a series of preparedness and coping actions. These tests will also contain measures of emotional arousal and perceived earthquake severity and susceptibility.

Exploring Resilience, Empathy, and Dual Mechanisms of Cognitive Control in the Context of the COVID-19 Pandemic. Jonah I. Borgenicht '22, Hanna R. Wright '23**,** & Todd D. Watson, *Department of Psychology, Lewis & Clark College*

In this remotely conducted study, we examined potential interrelationships between individual differences in self-reported trait resilience, empathy, cognitive control in the context of stressors, and perceived impacts of the ongoing COVID-19 pandemic in a community-based sample of young adults (N=33). Separately, we used a computerized adaptation of the classic Stroop paradigm designed to parse "proactive" (methodical, planned strategizing) and "reactive" (fast acting, corrective) aspects of cognitive control. We found that trait resilience was significantly associated with multiple aspects of cognitive control, but resilience and empathy were not strongly related. We also found that manipulations that differentially engage proactive and reactive cognitive control affected performance (alter response times and percentage of error trials) on the Stroop task, and that proactive and reactive control may be differentially related to resilience and empathy. Finally, we found that higher levels of resilience and cognitive control–but not empathy–correlated with lower self-reported impacts of the pandemic and lower overall stress levels. While the data suggest that aspects of cognitive control may predict both resilience and empathy, only cognitive control and resilience appear to be potential buffers against the adverse effects of the pandemic (and other stressors).

Racial Passing as a World-View Threat: How Racial Ideologies and Economic Scarcity Influence Perceptions of Racial Passers. Sonja Hanson '23, Dr Diana Leonard, *Department of Psychology, Lewis & Clark College*

This study aimed to replicate previous research that explores perceptions of racial passing and the effects of Colorblind ideology. In the present study, we added other ideological scales as well as a scarcity condition to investigate if these variables fostered more negative judgments of racial passers.

We found that ideology scale scores were correlated with behavior judgment, character judgment, and social distancing. We did not find any significant differences in judgements between the scarcity and control conditions. Further research to investigate these findings is necessary as well as a redesign of our scarcity condition to yield significant results.

Why has PLD activity diversified in sicariid venoms? Functional relevance of venom toxin diversification.

Jemma Montgomery, Sofia Reeves, Lindy Gewin, Matthew HJ Cordes, Greta J Binford

Venoms of sicariid spiders, including brown recluse and six-eyed sand spiders, are dominated by a diverse set of phospholipase D toxins which are primarily responsible for the spider's toxic bite. These toxins represent a recruitment of a widespread chelicerate protein family for venom function (SicTox), an origin that occurred before the most recent common ancestor of sicariids. Once recruited, SicTox variants have evolved preference for different cell membrane phospholipid substrates: some specifically cleave ceramide headgroups like sphingomyelin (SM), some cleave ethanolamine headgroups like ceramide phosphoethanolamine (CPE), while others act on both SM and CPE. The cellular membrane of possible targets of sicariidae spiders is also diverse. Many insects (crickets and lepidoptera) have a roughly even mix of CPE and SM, some (dipterans) have more CPE than SM, and other animals including Caenorhabditis elegans and mammals have more SM than CPE. We hypothesize that differences in enzymatic specificities reflect different potencies on living targets. To test this, we experimentally compared the percent cytotoxicity on cultured Sf9 cells from the lepidopteran Spodoptera frugiperda of three extant venom proteins that represent distinct phospholipid substrate preferences. We compare cytotoxicities to each other and to non-venom expressed SicTox proteins. Finally, we perform comparative LD50 assays on Drosophila melanogaster to see if different phospholipid specificities confer different toxicity on whole organisms. Our assays detect cytotoxic activity from all of the venom proteins on Sf9 cells. A CPE specific venom protein isolated from Sicarius terrosus has consistently higher cytotoxic effects than the other venom proteins while the nonspecific and SM specific venom proteins have trended higher than the buffer controls. Bioassays and continued cytotoxicity assays are in progress.

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