Undergraduate Research and Creative Work

8 December 2023 – 9:30am to 12:30pm
Virtual Showcase
Honolulu, Hawai‘i

SCHEDULE & MEETING INFORMATION

TIME	ACTIVITY	LOCATION
9:30-9:40a	Welcome	Main Room
9:45-11:15a	Showcase Oral Sessions • Arts & Humanities, Social Sciences • Engineering and Computer Sciences, Natural Sciences • Natural Sciences • Engineering and Computer Sciences, Natural Sciences • Natural Sciences	ʻIlima Room Kalo Room Limu Kohu Room Olonā Room Puakala Room
Please join us for the release reception of volume VIII of the Horizons *undergraduate journal*		
11:30a-12:20p	*Horizons* Release Reception Student Panel	Main Room
12:20-12:30p	Closing	Main Room

SESSION	ZOOM LINK	MEETING ID
Main	https://go.hawaii.edu/M4x	910 2258 7603
ʻIlima	https://go.hawaii.edu/E4x	917 5418 2568
Kalo	https://go.hawaii.edu/XNx	920 2181 7039
Limu Kohu	https://go.hawaii.edu/xNy	986 3830 4444
Olonā	https://go.hawaii.edu/C4x	998 1963 8583
Puakala	https://go.hawaii.edu/q4x	941 3481 1836
Password for all rooms: showcase		

Oral Session
9:45 - 11:15a

‘Ilima Room

Vanya Alvarado, Alexander Cleary	Stitches: Exploring Conflicts within Multiracial Families through Genre Challenging Narrative
Erin Arashiro, Aleta Hammerich	Highlighting Female Interpersonal Relationship through Film: Mother-Daughter Short Narrative Film (Title TBD)
Adriana Muñoz	Addressing Inclusivity in Hawai‘i’s Art Museums: Accessibility Strategies for Visitors Who Are Blind or Have Low Vision
Tonga (Jensen) Ahokovi	Taxation-Induced Tenancy: Evaluating Washington D.C.’s Vacancy Tax
Abigail Hawkins	Paranoia in the Pseudo-public: The Aesthetics of Kaka'ako's Redevelopment
Nadia Apo Takayama	The Role of Street Medicine Programs for Management of Diabetic Foot Ulcers Among Unsheltered Individuals Living in Hawai‘i

Oral Session
9:45 - 11:15a

Kalo Room

MJ Dinong	Synthesis of Copper Nanoparticles via the Thermal Decompostion of Copper Complexes of 1,1,3,3 Tetramethylguanidine
Jared Sloan	Sequence Adaptation in Various Environments across Organisms; Similar yet Different Superoxide Dismutase
Garett Costa, Michael Dodge, Jonavan Gonzalez, Jewel Johnston, Russell Laudone, Precious Pangelinan, Perrine Vacher	Lava Viscometer
Jonathan Cai	Saving Our Land
Luisa Brehmer	Title TBA

Oral Session
9:45 - 11:15a

Limu Kohu Room

Thomas Nitta, Edoardo Sena	Non-Transgenic Mutagenesis Breeding of Zooxanthellae to Improve Heat and pH Resilience and Tolerance of the Coral Microalgae
Cielo Anne Carnate	Genetic Relationships of the Lava Cricket: *Caconemobius* Within Hawai‘i Island Lava Flows
Michael Yamada	ZooScanning the Sea
Alena Albertson	The Role of IRE1A and IRE1B in Unfolded Protein Response (UPR) and the Impact of PDI9 in Heat-Stressed Plants
Joseph Romero	*Schrankia* Living on the Island of Hawai'i

Oral Session
9:45 - 11:15a

Olonā Room

Jasmine Carpena	Exploring the Maximum Likelihood Threshold of Gaussian Graphical Models
Jared Lo	Optimization of I/O-Efficient Parallel Algorithms on Graphics Processing Units
Jenny Brown	Investigating the Security Measures of Holocards: Implications and Vulnerabilities
Rachel Haynes	Developing an Additive Manufacturing Process for Fabricating Wearable Biochemical Sensors
Benjamin Ku, Christian Pak, Cal Tashiro	Measuring Impact Location and Force in Video using Neural Networks
Melissa Zakala-Downs	Optimizing Analytical Methods for Intracellular Microbial Polymers in Environmental Applications

Oral Session
9:45 - 11:15a

Puakala Room

Christian Fernando-Alonzo	The Role of Phosphoglucomutase 5 in Embryonic Development
Cade Kane	Identification of Biomarkers for Colorectal Cancer
Kalista Kahoekapu	Immobilizing Antibodies on a Solid Surface and Visualizing with Surface Plasmon Resonance
Ju-Ling Chen	Investigating the Regulation of Tight Junction Pores for Enhancing Paracellular Permeation of Small Molecule Therapeutics at the Blood-Brain Barrier
Princess Jena D. Santiago	The Characterization of Mice Lacking the Gene for Selenocysteine Lyase in Brown Adipocytes
Kenneth Lin, Kulani DeSimone	Engineering a Smart Biotechnological Growth Chamber with the Purpose of Improving Food Security

ABSTRACTS

Abstracts of oral and poster presentations are listed in alphabetical order of presenter's last name. Information below the name includes the student's major, the category of their presentation, and time/location of presentation. If appropriate, the faculty mentor's name, as given by the student, is listed below the abstract.

Group abstracts are listed alphabetically by the Last Name of the group member whose name occurs below:

Vanya Alvarado, Alexander Cleary
Erin Arashiro, Aleta Hammerich
Garett Costa, Michael Dodge, Jonavan Gonzalez, Jewel Johnston, Russell Laudone, Precious Pangelinan, Perrine Vacher
Benjamin Ku, Christian Pak, Cal Tashiro
Kenneth Lin, Kulani DeSimone
Thomas Nitta, Edoardo Sena

Tonga (Jensen) Ahokovi
Economics
Social Sciences
Independent Research
Oral Presentation Room: ‘Ilima

Taxation-Induced Tenancy: Evaluating Washington D.C.’s Vacancy Tax

Local governments in the United States and abroad are exploring taxes on "empty homes"/vacant housing to combat urban decay and shortages of affordable housing. Notwithstanding, there remains a notable gap in the research evaluating the impact of this policy, thereby impeding evidence-based policy deliberations. This study provides novel empirical insights, contributing to a small but growing literature on the effects of vacancy taxation.

Assessing the effects of vacancy taxation presents difficulties due to the non-random implementation of the policy. To address this, I examine the 2010 expansion of Washington D.C.’s vacancy tax as a natural experiment. Further, I employ a Synthetic Difference-in-Differences design to estimate a counterfactual D.C. – what would have occurred in D.C. if the tax was not expanded.

Drawing on data from the U.S. Census Bureau's American Community Survey, I find that D.C.’s expanded vacancy tax reduced vacancies by 30% and increased occupancies by 9%. These findings are robust across different control units and an alternate synthetic control method. However, I also find mixed evidence that the tax increased home prices and rents.

This research carries implications for policymakers contemplating vacancy taxes. Although my findings confirm the policy’s efficacy in reducing vacancies and increasing occupancies, they also suggest that such a tax may increase home prices and rents. These effects complicate the welfare analysis of vacancy taxation and warrant further investigation.

Mentor: Dr. Dylan Moore

Alena Albertson
Molecular Bioscience & Biotechnology
Natural Sciences
Maximizing Access to Research Careers (MARC) Scholar
Oral Presentation Room: Limu Kohu

The Role of IRE1A and IRE1B in Unfolded Protein Response (UPR) and the Impact of PDI9 in Heat-Stressed Plants

Global warming induces heat stress in plants, leading to diminished crop yields. This stress triggers protein unfolding, activating the unfolded protein response (UPR) in the endoplasmic reticulum (ER). The UPR aims to restore protein function by upregulating specific proteins, notably protein disulfide isomerase 9 (PDI9), which aids protein folding by catalyzing intramolecular cystine bonds. This investigation explores the impact of IRE1A and IRE1B knockout mutants on the UPR and defines into PDI9's role in the heat rescue response.

Genomic PCR confirmed the *ire1A/ire1B* knockout mutants, validated by comparing PCR products to controls: single mutant *IRE1A*, single mutant *IRE1B*, and wild-type (WT) Arabidopsis plants. PDI9 overexpression (OE) was confirmed via immunoblot analysis, revealing a fourfold increase in PDI9 concentration in the OE lines compared to WT samples. The UPR in Arabidopsis protoplasts will be assessed using laser scanning confocal microscopy of GFP fluorescence from the bZIP60-intron-GFP-bioreporter, with appropriate WT controls. The influence of PDI9 on the UPR will be deduced by reintroducing PDI9 (cherry-PDI9 fusion) into the double mutant, *pdi9/pdi10*, with and without UPR induction, visualized through confocal microscopy of the bZIP60-intron: GFP-bioreporter to measure UPR.

In conclusion, this study successfully created and validated *ire1a/ire1b* knockout mutants, affirming PDI9 overexpression. The research seeks to unravel the roles of IRE1A, IRE1B, and PDI9 in the UPR and protein folding during plant heat stress, contributing to our understanding of plant responses, and aiding in mitigating climate change's impact on food security.

Mentors: Dr. David Christopher, Ph.D. Candidate Rina Carrillo

Vanya Alvarado, Digital Cinema
Alexander Cleary, Digital Cinema
Arts & Humanities - Creative
UROP
Oral Presentation Room: ‘Ilima

Stitches: Exploring Conflicts within Multiracial Families through Genre Challenging Narrative

Stitches is a melodramatic dark comedy short film that follows Connor, the former star of a children’s program called “The Marionettes”. He is genetically both human and puppet, with his appearance being more human. This film investigates disparities within multiracial families specifically with biracial individuals, which is explored through the narrative of Connor’s relationship with the family he’s become estranged from. Throughout the film we see these relationships during different stages of Connor’s life.

We began with our pre-production phase, a preliminary phase in which myself and other members of my film crew collaborated in preparation of making the film. I collaborated with other individuals that have experience in multiracial or diasporic families in order to strengthen the script to authentically explore and reflect the experiences and themes of the film. We then moved into our production phase to film said story. I casted a biracial actor as our main character and encouraged them to take the character in a very personal direction, which expanded the authentic representations and themes of our film. The UROP funding was crucial as it allowed us to purchase props, wardrobe, equipment, location fees, and so much more.

After wrapping filming we entered the post production phase, in which we began editing. The final film is a tangible culmination of our themes and investigations formatted into an audience accessible short film. The result is a film that is representative and relatable of the themes of biracial struggle in multiracial families.

Mentor: Anne Misawa

Co-Authors: Aleta Hammerich, Beck Hong

Nadia Apo Takayama
Public Health (B.A.) and Biology (B.A.)
Social Sciences
Honors
Oral Presentation Room: ʻIlima

The Role of Street Medicine Programs for Management of Diabetic Foot Ulcers Among Unsheltered Individuals Living in Hawaiʻi

Diabetes mellitus is a chronic disease that can cause a host of severe complications, such as a diabetic foot ulcer (DFU). When left unmanaged, a DFU can progress from a simple wound to a severe infection that may be treated with a lower limb amputation. There are many risk factors for developing diabetes and diabetic foot ulcers; one factor is being an unsheltered individual. This investigation aims to compare a Maui-based Street Medicine program, Mālama I Ke Ola Street Medicine program, to similar programs state and nationwide to understand the roles these programs play in DFU management. A review of Mālama I Ke Ola Street Medicine program was completed through a shadowing experience of the program along with information provided by the program's lead community health worker. Reviews on similar programs nationwide were completed using published program statistics, program website analysis, and information provided by a volunteer from one of the programs. Comparisons among each program showed numerous similarities in operations, including a regular schedule of wound care on the street visits, connections with a local clinic, and an overall decrease in emergency department visits among impacted populations. Mālama I Ke Ola Street Medicine program's lead community health worker suggests that a permanent provider on the medical team and increased advocacy for funding could add to the already successful program. While these suggestions could build upon the program, the Street Medicine team has made a significantly positive impact on Maui's unsheltered populations by increasing access to healthcare.

Mentor: Dr. Vanessa Buchthal

Erin Arashiro, Cinematic Arts
Aleta Hammerich, Cinematic Arts
Arts & Humanities - Creative
UROP
Oral Presentation Room: ‘Ilima

Highlighting Female Interpersonal Relationship through Film: Mother-Daughter Short Narrative Film (Title TBD)

The film (Title TBD) is a short narrative film about the unique relationship between a single mother and her daughter who reunite at a funeral for the grandmother. This relationship showcases the complexities of female relationships including but not limited to: ideas about how women are viewed in society, generational trauma, and how that impacts interpersonal relationships.

This film has an experimental nonlinear structure that works to share intimate feminine moments and subvert the usual Hollywood structure that was formed by men for a male audience. Through these techniques, we share an authentic story that subverts the tropes that female characters are typically written into, by creating three-dimensional characters with flaws and goals outside of the male gaze.

The methodology follows the traditional phases of filmmaking: pre production, production, and post production. In pre-production the team creates a shoot schedule, a shot list, and a storyboard in order to ensure the production goes as smoothly as possible. In production, crew films according to the schedule and storyboards. In post-production the editor and director work together to create a cohesive and interesting cut of the film that tells the story to the best of their ability. This cut of the film will be shared with mentors and peers for review and reworked into a final cut.

This film empowers women, nonbinary, and non-gender conforming creatives to uplift one another as each of the heads of departments are led by the demographic of the story being told.

Mentor: Professor Anne Misawa

Luisa Brehmer
UROP
Oral Presentation Room: Kalo

(Title TBA)

(no abstract submitted)

Jenny Brown
Electrical Engineering
Engineering & Computer Sciences - Research
UROP
Oral Presentation Room: Olonā

Investigating the Security Measures of Holocards: Implications and Vulnerabilities

This project's aim was to assess the security of the UPASS system, a prepaid smart card used for public transit in Hawai'i. The UPASS system includes cards with embedded RFID tags, and is used by both university students as well as the general public for Honolulu's TheBus public transit via HOLO cards. This project sought to understand and find potential weaknesses in UPASS's security by studying the underlying security implemented on the RFID tags embedded in UPASS cards.

In our research, we have found potential attacks that may be of concern for the UPASS system. We've attempted to work with the administrators of the HOLO card system to discuss our findings and gather background information for potential weaknesses - thus far we have been unable to establish a research collaboration; however we continue to discuss the possibility. We also explored the possibility of cloning UPASS RFID tags using commercially available RFID cloning equipment, finding that the current version of tags is resistant to cloning attacks. Lastly, we have employed reverse engineering tools to discover the current UPASS card security algorithms.

Mentor: Paul Schmitt

Jonathan Cai
Civil Engineering
Engineering & Computer Sciences - Research
UROP
Oral Presentation Room: Kalo

Saving Our Land

In the context of the ocean, sand savers typically refer to structures or other natural features that trap or accumulate sand to aid in preventing coastal erosion. These characteristics serve as barriers, slowing the flow of sand and keeping waves and currents from carrying it away. In this study, we present a photogrammetric imaging application called structure from motion (SfM) that uses geometry and computer vision to build three-dimensional (3D) models from a collection of two-dimensional (2D) photos. A complete 3D model of the beach profile can be recreated by taking a series of overlapping photos of the shoreline and applying SfM algorithms. This model provides a dynamic representation of the shoreline, dunes, ripples, and other features, allowing for precise slope measurements, elevation changes, and erosion identification. The results are contrasted with another method of measuring sand slope that uses a standard point gauge. A transect was taken out of the 3D models and contrasted with data that was collected by hand. Based on the measured beach, it was evident from the results that sand savers had a significant effect in reducing sand flow and preventing waves from shifting it away. We investigated the potential applications of this method to evaluate dynamic alterations in the beach profile within a small wave flume.

Mentor: Dr. Zhenhua Huang

Cielo Anne Carnate
Biology and Women, Gender, and Sexuality Studies
Minor in English
Natural Sciences
UROP
Oral Presentation Room: Limu Kohu

Genetic Relationships of the Lava Cricket: *Caconemobius* Within Hawai‘i Island Lava Flows

Hawai’i is one of the most biologically diverse regions in the world due to its geographical isolation. The young age of the island of Hawai'i provides an evolutionary timeline for exploring speciation and species dispersal. The pahoehoe lava tubes in Hawai'i provide a unique opportunity for study of species and ecology in order to fully understand the extent of biodiversity in Hawaii. The lava tubes are home to an understudied group of cave-adapted arthropods, including the cave cricket genus *Caconemobius.* Among the first species to colonize lava flows, crickets provide the anchor that allows other species to inhabit lava flows. In the lava tube community, little is known about species interactions and gene flow. The goal of this project is to study whether the population structure through the genetics of *Caconemobius* correlates with the age and geography of the Hawaiian lava flows across the island. I will collect five *Caconemobius* specimens from each of the different lava flows from three volcanoes. Using the CO1 gene, I will DNA barcode each cricket to identify the species, and use this to generate a phylogenetic tree showing the genetic relationships between crickets from the different lava flows. By understanding the gene flow and population structure of Caconemobius, we can better understand the overall arthropod ecosystem within lava tubes. This information will help characterize biodiversity in Hawai‘i, including those in caves, which is important considering that biodiversity is dwindling at an accelerated rate.

Mentors: Dr. Rebecca Chong, Dr. Megan Porter

Jasmine Carpena
Mathematics
Natural Sciences
UROP, Maximizing Access to Research Careers (MARC) Scholar
Oral Presentation Room: Olonā

Exploring the Maximum Likelihood Threshold of Gaussian Graphical Models

In this research, we investigate graphical models with a focus on maintaining the maximum likelihood threshold (MLT). Graphical models play a vital role in representing complex relationships between variables, such as gene regulatory networks in biology and microbiome data analysis. We aim to address the challenge of having a sufficient number of data points relative to the variables for a maximum likelihood estimate (MLE) to exist.

Our main hypothesis is that by leveraging combinatorics and algebraic statistics, we can adapt model selection methods to suit small datasets, where observations are fewer than variables. We aim to develop strategies and techniques that ensure the validity of maximum likelihood estimation in small-sample scenarios.

Our initial approach involves a comprehensive examination of various graph properties, such as planarity and the clique number, to understand how MLE changes with the graph's combinatorial structure. We plan to use these insights, along with other relevant properties, to maintain the maximum likelihood threshold in graphical models.

Our project focuses on small graphs to explore the space of graphs with a fixed maximum likelihood threshold. We will study the effects of simple operations like edge swapping, removal, and addition to determine if these actions maintain the fixed threshold. By enhancing our understanding of preserving the maximum likelihood threshold in graphs, we aim to contribute to network sampling, model selection, and statistical inference in the field of biological sciences.

Mentor: Dr. Elizabeth Gross

Ju-Ling Chen
Biochemistry
Minor in Psychology
Natural Sciences
UROP
Oral Presentation Room: Puakala

Investigating the Regulation of Tight Junction Pores for Enhancing Paracellular Permeation of Small Molecule Therapeutics at the Blood-Brain Barrier

Organ and blood vessel surfaces are protected by sheets of closely joined cells, where cell-cell adhesion points are sealed by tight junctions (TJs) placed apically in the intercellular space. TJs are protein complexes that inhibit the free diffusion of molecules, preventing leakage between cell compartments. The TJ barrier is primarily composed of claudins, which are a family of proteins that polymerize in the membrane to create a continuous network of pores called TJ strands. The blood-brain barrier (BBB) uses TJ proteins to maintain the integrity of the endothelial cell lining of brain blood vessels, with claudin-5 being the most enriched TJ protein in the BBB, and its dysfunction has given rise to various neurodegenerative disorders. Furthermore, claudin-9 is essential for nervous system development and expressed in the cerebellum and cells in the cochlea.

TJ models thus far have focused on claudin assembly and ion permeation but has yet to address drug delivery strategies along the paracellular pathway. In this study, an all-atom model of TJs was developed to understand the mechanisms of paracellular permeation. The crystal structure of claudin-9 and claudin-5 were used to computationally model triple-pore arrangements between two lipid bilayers solvated under physiological conditions. The stability of these systems was observed over 1 μs long simulations, and the free energy of the permeation and the local diffusivity were computed with umbrella sampling calculations. This research will lay the groundwork for future steps in assessing the free energy change in the presence of chemical permeation enhancers.

Mentors: Dr. Rui Sun, Mabel Bernaldez, Christopher Kang

Garett Costa, Mechanical Engineering
Michael Dodge, Mechanical Engineering
Jonavan Gonzalez, Mechanical Engineering
Jewel Johnston, Mechanical Engineering
Russell Laudone, Mechanical Engineering
Precious Pangelinan, Mechanical Engineering
Perrine Vacher, Marine Biology and Biological Oceanography
Engineering & Computer Sciences - Product Design/Development
UROP, Senior Design for Mechanical Engineering
Oral Presentation Room: Kalo

Lava Viscometer

Team Lava's mission is to improve an existing Lava Viscometer to accurately determine the viscosity and temperature of lava on the Big Island of Hawai'i. Hawai'i island currently has two active volcanoes: Kīlauea and Mauna Loa. In 2018, Kīlauea erupted and destroyed over 700 homes. By redesigning and testing the existing prototype, the measurement accuracy and data communication will be enhanced. The viscometer would provide researchers with valuable information regarding the composition, flow speed, and temperature of Pāhoehoe and 'A'ā lava flows to improve the emergency response time and potentially mitigate property damage.

Improvements to the existing design include two rotating vanes and a revamped electrical system. The alternative vane design consists of a stationary outer cup with the initial four-finned rotating spindle. Both vanes were constructed of metals for high temperature applications: stainless steel 304, 310, 321, and Inconel 625. Through testing various Newtonian and non-Newtonian fluids, the isothermal results performed on the original vane design were compared to the Geology Department's calibrated rheometer with statistical t-tests. Additional high-temperature testing will be performed in collaboration with the Art Department using molten basalt fluid. Enhancements were made for the electronics including: user-accessibility for real-time measurements, processing power, and data analysis capabilities. With these proposed modifications, an additional adjustment to the K-type thermocouple will be integrated into the rotating vane with real-time temperature readings on the display module.

Mentor: Dr. John Allen III

MJ Dinong
Molecular Bioscience & Biotechnology
Minor in Chemistry
Natural Sciences
Maximizing Access to Research Careers (MARC) Scholar
Oral Presentation Room: Kalo

Synthesis of Copper Nanoparticles via the Thermal Decompostion of Copper Complexes of 1,1,3,3 Tetramethylguanidine

Copper nanoparticles (Cu NPs) find catalytic applications in a wide variety of chemical processes, including Copper Azide Alkyne Cycloaddition reactions (CuAAC), also known as Click Chemistry. We are interested in developing methods for the synthesis of this versatile nanomaterial.

A series of copper complexes were synthesized and characterized via FT-IR spectroscopy and ^{1}H NMR spectroscopy. One such complex is utilized in the synthesis of Cu NPs and the resultant NPs were further characterized by UV-Vis Spectroscopy. All syntheses were performed under an atmosphere of N_2. This series of complexes were prepared by reacting $CuCl_2$ and CuCl with stoichiometric ratios of 1,1,3,3-Tetramethylguanidine (H-TMG) to isolate $[CuCl_2(H\text{-}TMG)_2]$ (**1**) and {CuCl(HTMG)] (**2**), respectively. Complexes **1** and **2** were subsequently reacted *in situ* with lithium bistrimethlylsilylamide to respectively isolate novel amido complexes **3** and **4**. With olelyamine as a capping agent, complex **4** was injected into a heated hexadecylamine solution in an attempt to form Cu NPs. The resultant particles were washed with methanol and suspended in toluene or dichloromethane.

The structural analysis of complexes **2**-**4**, and resultant NPs is currently under investigation.

In future studies, the use of these NPs as catalysts in CuAAC reactions may be undertaken.

Mentor: Dr.Scott D Bunge

Christian Fernando-Alonzo
Biology (B.S) and Psychology (B.S.)
Natural Sciences
Maximizing Access to Research Careers (MARC) Scholar
Oral Presentation Room: Puakala

The Role of Phosphoglucomutase 5 in Embryonic Development

Phosphoglucomutase 5 (PGM5) is an enigmatic member of the PGM family of glycolytic enzymes. Studies in muscle tissue suggest PGM5 serves as a structural protein promoting cell-cell adhesion in association with cytoskeletal proteins, which distinguishes PGM5 from the other four PGM proteins that clearly function as enzymes. While some members of the PGM family have been shown to be essential for development using mouse models, it has not been determined whether this is the case for PGM5. This project will determine whether PGM5 deficiency in mice is embryonic lethal and, if not, whether $PGM5^{-/-}$ mice present any phenotype. To this end, we have successfully carried out a breeding scheme that generated offspring with PGM5 deleted at both alleles, i.e., a homozygous knockout mouse. Results showed that PGM5 deficiency in mice is not embryonic lethal, with $PGM5^{-/-}$ mice being born and living to the adult stage of life. The plan moving forward is to generate more $PGM5^{-/-}$ mice to compare homozygous, heterozygous, and wild type mutant mice for possible phenotypes involving muscle function. Our western blot results show that wild type mice express high levels of PGM5 protein in cardiac, skeletal, and smooth muscle. To begin, these mice will complete a series of treadmill-based exercise tolerance tests to analyze collective performance of cardiac, smooth, and skeletal muscle. Based on these results, we intend to utilize cells from $PGM5^{-/-}$ mice to investigate the role of this protein in muscle function.

Mentor: Dr. Peter Hoffmann

Co-Authors: Lance GA Nunes, Ryan Wright

Abigail Hawkins
Geography & the Environment
Arts & Humanities - Creative
UROP
Oral Presentation Room: ‘Ilima

Paranoia in the Pseudo-public: The Aesthetics of Kaka'ako's Redevelopment

A zine about the artist’s struggles with alienation, guilt, shame, and ‘local’ identity inspired by time spent in Kaka‘ako throughout their life. A relation to and reflection on the neighborhood’s redeveloped urban environment and how Hawai‘i can be a hotbed of class stratification and racial strife not only for a certain type of person, but for all its residents and tourists in one way or another. A marginalized person’s attempt to reclaim their voice and experiences of identity paranoia; an experiment in emotion and a disruption to the idea of this place as ‘paradise.’

Mentor: Dr. Dan Milz

Rachel Haynes
Mechanical Engineering
Engineering & Computer Sciences - Research
Maximizing Access to Research Careers (MARC) Scholar
Oral Presentation Room: Olonā

Developing an Additive Manufacturing Process for Fabricating Wearable Biochemical Sensors

Additive manufacturing, commonly known as 3D printing, has paved the way for precise, customizable, and straightforward fabrication of material which can contribute toward technological advancements in patient healthcare. The development of electrochemical sensors through the process of additive manufacturing can enable local manufacturing of point-of-need testing, promoting cost-effectiveness, accessibility, and environmentally sustainable manufacturing methods. Utilizing the VolteraNova, an additive manufacturing machine capable of printing flexible electronic components using carbon and silver inks, the production of electrochemical sensors is readily achievable and can be deployed as needed. Carbon ink-based sensors have demonstrated beneficial conductive properties and biocompatibility that can play a pivotal role in enhancing the sensor's response characteristics and sensitivity. To study the conductive properties of carbon ink, a variety of sensors were created using three different carbon inks: carbon filled flexible conductive trace ink (FE3203), single-walled carbon nanotube solvent-based conductive ink (SWCNT) and Intexar™ stretchable, washable carbon ink (PE672). Sensors were produced using each of the inks and tested using a potentiostat. The test results from the cyclic voltammetry analysis showed that carbon ink alone is not conductive enough to produce a sufficient response. To combat this issue, graphite was mixed into the different carbon inks which were then printed and tested. Graphite possesses highly electrocatalytic characteristics, and the addition to the carbon ink helped to significantly improve the electrochemical properties of the mixture. Future plans include incorporating the electrochemical sensors into wearable devices to facilitate real-time monitoring and evaluation of a wide variety of health parameters. The subsequent devices will be further tested for the production of wearable electronics.

Mentors: Dr. Tyler Ray, Kaylee Clark

Kalista Kahoekapu
Biology
Minor in Public Health
Natural Sciences
Maximizing Access to Research Careers (MARC) Scholar
Oral Presentation Room: Puakala

Immobilizing Antibodies on a Solid Surface and Visualizing with Surface Plasmon Resonance

The human immunodeficiency virus is responsible for millions of deaths. There were 1.3 million people who acquired HIV in 2022. This statistic can be directly impacted by creating an effective vaccine that will help to prevent the spread of HIV. Broadly neutralizing antibodies (bnAbs) that were isolated from chronically infected patients target conserved regions on the virus. The VRC01 antibody targets the CD4 binding site of HIV. 97% of humans naturally create VRC01 antibodies, however the naïve b-cell requires a long evolutionary process to acquire the wildtype phenotype.

The objective of this project is to use surface plasmon resonance (SPR) to determine the binding kinetics of a previously constructed immunogen to VRC01 antibodies. We hypothesize that our engineered immunogen will bind with high affinity to help elicit a response from VRC01-class B-cells.

We are testing the Strep-tag system for antibody immobilization on the SPR sensor. Strep-tag sequences were added to VRC01 using a cloning method, and the constructs were expressed in ExpiCHO cells. As an intermediate step, we confirmed that the system works for attachment of VRC01 by using a pull down assay with biotin-coated beads. For SPR, we observed a signal of 8000 response units (RU) when adding Strep-tactin to a biotin-functionalized sensor, and we observed a signal of 3000 RU when strep-tagged VRC01 antibody is bound to Streptactin. We observed 200-300 RU when measuring our immunogen binding to VRC01. We plan to further work with SPR to determine kinetic binding constants of our immunogen with VRC01-type antibodies.

Mentors: Dr. Iain MacPherson, Ryan Bailey

Cade Kane
Computer Science
Minor in Biology
Natural Sciences
Maximizing Access to Research Careers (MARC) Scholar
Oral Presentation Room: Puakala

Identification of Biomarkers for Colorectal Cancer

Colorectal cancer (CRC) is the fourth most common cancer and second most common cause of cancer-related death in the United States. Furthermore, its incidence and mortality rates demonstrate disparities across different racial/ethnic populations.

This research project aims to identify and analyze biomarkers associated with CRC by analyzing open and controlled datasets from curated databases, such as The Cancer Genome Atlas (TCGA). It also aims to focus on the unique context of multiethnic health disparities in CRC. To accomplish this, whole genome sequencing (WGS) and whole exome sequencing (WXS) data will be used to comprehensively examine the genetic landscape caused by the development of CRC.

The Oliver-Cromwell DNA sequencing (DNAseq) pipeline for analyzing WGS data was successfully carried out on ten colorectal cancer samples to generate mutation annotation format (.maf) files. These were analyzed using the R programming language to visualize the variant genome associated with the cancer. These included the type of mutations, their frequency, and most common mutated genes. Colorectal cancer WXS data was also successfully downloaded from TCGA and annotated for further processing.

Ultimately, by integrating these data, this project aims to gain a deeper understanding of differing molecular processes behind CRC in Native Hawaiian, African American, Asian, and other ethnic populations.

Mentors: Dr. Youping Deng, Dr. Yuanyuan Fu

Benjamin Ku, Mechanical Engineering
Christian Pak, Mechanical Engineering
Cal Tashiro, Mechanical Engineering
Engineering & Computer Sciences - Research
UROP
Oral Presentation Room: Olonā

Measuring Impact Location and Force in Video using Neural Networks

Our research project is a novel method to use video analysis to quantify the location and force of impacts. While sensors to measure force distributions exist, current solutions rely on expensive and complex sensors that are difficult to integrate into equipment. Obtaining pressure distribution in video would allow for data collection for biomechanics and sports studies without the need for specialized equipment. Our project aims to solve this problem by leveraging video analysis through neural networks. Neural networks are machine learning algorithms that can be trained to make predictions based on previous or training set data. Previously, hand pressure has been estimated from photographs using a neural network; however, these results were limited to specific lighting and background conditions. Building upon their encoder-decoder neural network method, our extended model integrates and compares multiple video types, including stereoscopic (depth) and infrared (temperature) as inputs. The neural network is trained using data from a pressure mapping sensor, serving as the reference label. This project allows for a non-intrusive solution to measure impacts accurately, eliminating the need for elaborate sensor configurations, even in environments where traditional setups are impractical.

Mentor: Dr. John Allen

Kenneth Lin, Biology
Kulani DeSimone, Molecular Biosciences & Biotechnology
Natural Sciences
UROP
Oral Presentation Room: Puakala

Engineering a Smart Biotechnological Growth Chamber with the Purpose of Improving Food Security

The surge in mushroom investment has gained prominence in recent centuries due to its provision of essential macronutrients, health-boosting vitamins, and antioxidants. This project aims to develop a versatile biotechnological growth chamber, with the ultimate goal of introducing mushroom-growing technology into households, fulfilling the demand for mushroom consumption worldwide. The study involves the evaluation of lion's mane growth under two different conditions: (1) within the Mella™ (growth chamber) and (2) with modifications to the Mella™ for different atmospheric environments. This comprehensive project assesses and hypothesizes the efficiency of achieving higher quality and rapid growth by collectively optimizing the growth chamber for the ideal conditions required for the home cultivation of lion's mane.

The complete versatile optimized growth chamber for a mushroom cultivation environment is designed to contain monitoring sensors. While adjusting environmental parameters (O_2, CO_2, and Ozone), data will be collected for maximization of the production and growth rate of the lion's mane.

Results demonstrated that home-growing mushrooms with a chamber actively lower the risk of contamination. However, growth is not optimal with temperature and oxygen levels shown from the pigmentation and size of the mushroom. With interpretations, the modified Mella™ would create an optimal environment that allows ideal mushroom growth, containing valuable and effective macronutrients and antioxidants. However, further experiments will allow more accurate results.

This project also potentially lays down the foundation for future bioprospecting using mushrooms from Hawaii as a source of bioactive components as unidentified mushrooms may have possible bioactive components that can benefit human health.

Mentor: Dr. Jon-Paul Bingham

Jared Lo
Computer Science
Minor in Mathematics
Engineering & Computer Sciences - Research
UROP
Oral Presentation Room: Olonā

Optimization of I/O-Efficient Parallel Algorithms on Graphics Processing Units

Computers have evolved significantly in the past decades through hardware and software optimizations on single-core machines. However, improving speed on a single core has proved incredibly challenging. As a result, many computers we have today use multi-core processors to improve speed – most of the latest laptops have at least 11 cores. The research presented here is focused on powerful machines called Graphics Processing Units (GPUs), which have cores that number in the thousands - for instance, the Nvidia GeForce RTX 3090 has 10496 general-purpose cores.

Along with the increased number of cores on these units also lies the challenge of optimizing performance. Algorithms written on GPUs require weighing many different tradeoffs. For instance, re-doing computation is generally frowned upon, but out of the interest of minimizing requests from global memory (which tends to be slow), this tradeoff may significantly improve runtime.

In this presentation, we demonstrate the tradeoffs made for optimal implementations on prefix sums and merge sort. We discuss the effect of I/O requests, heavy synchronization of threads, register communication, bank conflicts, and varying the number of threads scheduled on the GPU. Additionally, we find that for some applications, a balance of computation in registers with computation in shared memory is more efficient than computation in strictly one or the other. We show that an increase of sources of slowdown such as bank conflicts and synchronization barriers in exchange for a decrease in global memory accesses prove to be more efficient.

Mentor: Dr. Nodari Sitchinava

Adriana Muñoz
Art History
Arts & Humanities - Research
Honors
Oral Presentation Room: ʻIlima

Addressing Inclusivity in Hawaiʻi's Art Museums: Accessibility Strategies for Visitors Who Are Blind or Have Low Vision

In the past few decades, art museums have adopted more policies highlighting diversity, equity, inclusion, and accessibility (DEIA). Of the DEIA practices, because of its broad definition and applications, accessibility in a disability context is often reduced to physical access. In addition to complying with the guidelines of the Americans with Disabilities Act (ADA), some institutions are expanding this definition by providing an engaging, educational, and satisfactory experience for all visitors. This research project broadly examines accessibility in Hawaiʻi's leading art museums, the Honolulu Museum of Art (HoMA), Shangri La Museum of Islamic Art, Culture and Design, and the Hawaiʻi State Art Museum (HiSAM), with a focus on their inclusive strategies for visitors who have visual impairments.

To assess the accessibility of Honolulu's art museums, interviews were conducted with museum educators across the country, who were chosen based on their expertise and experience in disability accessibility in art museums. In addition, a survey conducted between May and August 2022, examined the three museum's permanent and temporary exhibitions in terms of exhibition design, programming, and curatorial practices. The assessment revealed that HoMA, Shangri La, and HiSAM all adhered to the ADA guidelines, however, their policies and practices were predominantly limited to visual engagement. Thus, recommendations consisted the addition of supplementary materials, such as alternative forms of labels, an online gallery, and the incorporation of more multisensory works into the collections. It is hoped that the adoption of some of these accessibility strategies will also prompt creative methods of engagement.

Mentor: Dr. John Szostak

Thomas Nitta, Biology
Edoardo Sena, Marine Biology
Natural Sciences
UROP
Oral Presentation Room: Limu Kohu

Non-Transgenic Mutagenesis Breeding of Zooxanthellae to Improve Heat and pH Resilience and Tolerance of Coral Microalgae

Coral bleaching is a process observed when corals undergo high physiological stress due to environmental pressures, causing the symbiotic relationship with the dinoflagellates inside their tissue to break down. The algae are expelled from the coral tissue, rendering the coral white. These dinoflagellates, part of the family Symbiodiniaceae, provide energy to the corals from their products of photosynthesis, while the coral host provides benefits such as shelter and nitrogenous waste products. This symbiotic relationship is essential for coral reefs to exist in oligotrophic waters, but is under threat due to anthropogenic stressors such as global warming and ocean acidification. Research is ongoing to improve coral resilience, such as selective breeding and genetic engineering. This project focused on a novel approach toward coral resilience involving the random mutagenesis of the algal symbiont and subsequent screening for thermal and acid-tolerant mutants using *Chlamydomonas reinhardtii* and *Nannochloropsis oceanica* as model organisms. Growth chambers with shakers, variable light conditions, and variable temperatures were assembled.

Mentor: Dr. Zhi-Yan (Rock) Du

Joseph Romero
Biology
Natural Sciences
UROP
Oral Presentation Room: Limu Kohu

Schrankia Living on the Island of Hawai'i

Hawai’i contains a very biodiverse ecosystem due to the isolation between itself and other land formations. The island itself is very young and is still being shaped today by the volcanoes that exist on the island. When these volcanoes erupt, there is a chance that the lava flow could be pahoehoe which forms a lava tube. Lava tubes that exist on the island of Hawai’i host a very specific and diverse ecosystem that is very understudied. There are moths that live in the lava tubes that belong to the genus *Schrankia*, but very little is known about these lava tube adapted moths. The main goal of this project is to determine if the age and distance between lava tubes on the island of Hawai’i affects gene flow of *Schrankia*. Schrankia that are used will be from each lava flow from three different volcanoes. To compare the species found in each lava tube, I will be using the CO1 gene and DNA barcoding first identify the species. After identifying the species I will then create a phylogenetic tree which will show the relationship between each sample collected in each lava tube. Results that are produced can not only help with understanding the population structure of Schrankia, but the whole lava tube ecosystem which is being threatened by invasive species and the limited lifetime of lava tubes.

Mentor: Dr. Megan Porter

Princess Jena D. Santiago
Biochemistry
Natural Sciences
Honors, UROP
Oral Presentation Room: Puakala

The Characterization of Mice Lacking the Gene for Selenocysteine Lyase in Brown Adipocytes

Selenium (Se) is an essential micronutrient necessary for energy metabolism and thermoregulation. Brown adipocytes are responsible for producing heat and maintaining body temperature by expending energy. Selenocysteine lyase, Scly, is an enzyme that assists in recycling selenium in the body through the degradation of the amino acid selenocysteine (Sec), essential to the process of selenocysteine biosynthesis. Whole-body deletion of Scly leads to obesity and impaired glucose tolerance, with hepatic steatosis and enlargement and whitening of the brown adipocyte tissue (BAT). This project aims to examine the consequences of knocking out Scly in the brown adipocytes of mice.

We hypothesize that BAT-specific-Scly knock-out (KO) animals will exhibit metabolic dysfunction, including weight gain, glucose, and insulin intolerance. The goal will be achieved by feeding customized diets of known amounts of Se and exposing animals to the cold-initiating adaptive thermogenesis. Thermo probes were surgically implanted in the mice to record internal body temperature and glucose levels were measured. Western blotting assessed changes in specific selenoproteins associated with BAT thermogenic activity. Our results suggest that mice challenged with low Se diets exhibited higher weight gain and increased metabolic dysfunction compared to animals on moderate Se diets. The adaptive thermogenesis of mice was affected; mice with low Se-diets did not produce as much heat or maintained average body temperatures as moderate Se-diet-fed mice. Observing the KO of Scly in brown fat can provide information on the significant role of Se in energy expenditure and thermoregulation.

Mentors: Dr. Lucia A. Seale, Dr. Briana K. Shimada, Dr. Naghum Alfulaij, and Pamela Toh

Jared Sloan
Biology (B.A.)
Minor in Spanish
Natural Sciences
UROP
Oral Presentation Room: Kalo

Sequence Adaptation in Various Environments across Organisms; Similar yet Different Superoxide Dismutase

Superoxide dismutase (SOD) is an oxidoreductase that can convert radical oxygen species (ROS) into H_2O_2. and O_2, a crucial process for cell survival. SOD is a homodimer with Cu^{2+}/Zn^{2+} cofactors that is found in various cellular compartments and organisms. In this research, we focus on the environmental contribution to the SOD sequence adaptation utilizing two SOD proteins: human SOD 1 (hSOD1) and its bacterial homolog *Mycobacterium tuberculosis* SOD (MtSOD). While hSOD1 exists in the cytoplasm, MtSOD exists in the periplasm, where redox potential controls the formation of the disulfide bonds. Unlike hSOD1, MtSOD contains only Cu^{2+} binding sites as an adaptation to the Zn^{2+} deficient environment caused by the host immune response against *M. tuberculosis*. Both the metal cofactors and the disulfide bond play important roles in the protein dimerization that is essential for its biological activity. To determine the sequence adaptation in various organisms, we conducted thermodynamic experiments on these model proteins. Our results indicate that the SOD homologs share secondary structure similarities despite having a low sequence identity. Moreover, MtSOD, with only Cu^{2+} cofactor, has a similar stability when compared to the human protein with two metal cofactors. Therefore, we hypothesize that the loss of the Zn^{2+} binding site in MtSOD has no significant effect on enzymatic activity.

Mentor: Dr. Ellinor Haglund

Co-Author: Ivy Vo

Michael Yamada
Global Environmental Science
Natural Sciences
UROP
Oral Presentation Room: Limu Kohu

ZooScanning the Sea

Zooplankton, small animals that inhabit the water column, are the dominant secondary producers of the global ocean, and they serve several important roles in food web dynamics and ecosystem function. In the eastern tropical Pacific, midwater communities, including zooplankton, may be at risk due to the emerging industry of deep-sea mining of polymetallic nodules. This project examines deep-sea plankton samples collected in the Clarion Clipperton Zone (CCZ), as part of a baseline survey of ecosystem function prior to mining impact. Samples were collected over the NORI-D exploration mining claim in the CCZ using Multiple Opening-Closing Nets and an Environmental Sampling System to obtain depth-stratified material. These samples were analyzed to characterize zooplankton community structure, vertical distribution, and obtain taxon-specific estimates of abundance and biomass. We also assessed seasonal variation in these parameters through comparison of Fall and Spring cruises. We used images and machine learning methods as part of the ZooScan system, to capture images of preserved zooplankton, classifying them into taxonomic groups, and obtaining measurements of each organism that is scanned. Our study will provide some of the first quantitative estimates of abundance and biomass for all common taxa in an ocean region at near term risk of mining impacts.

Mentor: Dr. Erica Goetze

Melissa Zakala-Downs
Civil & Environmental Engineering
Engineering & Computer Sciences - Research
UROP
Oral Presentation Room: Olonā

Optimizing Analytical Methods for Intracellular Microbial Polymers in Environmental Applications

Polyhydroxyalkanoates (PHAs) are intracellular polymers with promising applications in various industries as a substitute for standard petroleum-based polymers due to their increased biodegradable properties. P3HB, P3HV, and P3HH are three forms of PHA, the accurate quantification of which is essential for optimizing the production processes of PHA. This research aims to develop an optimized analytical method for the quantification of PHA in forms P3HB, P3HV, and P3HH through variation of processing parameters and testing a range of biomass sources.

To quantify PHA, the polymer(s) were first extracted from biological cells and then depolymerized to their monomer form(s). They were quantified using a gas chromatogram (GC) equipped with flame ionization detection, and results were compared with externally created calibration curves to determine the percentage 3HB, 3HV, and 3HH yield of the samples by normalizing to initial dry mass. A series of temperatures (60°C - 140°C) and heating times (30 min - 2.5 hr) were then tested to determine the optimum processing conditions for maximum PHA yield.

It was found that the optimum length of the methylation and depolymerization stage was 1 hour, and the optimum temperature was 120°C. PHA yield was minimal for processing times less than 1 hour, and slightly lower for times exceeding 1.5 hours. Temperatures less than 100°C did not fully process the samples, and temperatures above 120°C degraded a significant portion of the PHA, leading to less desirable yields.

Mentor: Dr. Zhiyue Wang

Co-Author: Caitlin Niiya

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Horizons Vol VIII Release Reception

11:30-12:30 Student Panel

PROGRAM SCHEDULE

Welcome & Introduction……Dr. Shana Brown, Honors Director
Panel Discussion……Volume VIII Student Authors
Moderator: Dr. Siobhán Ní Dhonacha, Editor
Closing……Dr. Siobhán Ní Dhonacha, Editor

ABOUT THE JOURNAL

Horizons is a peer-reviewed academic journal dedicated to high-quality creativity, innovation, and research created, conducted, and synthesized by undergraduate students at the University of Hawai'i at Mānoa (UHM) in all academic fields represented by the UHM campus community.

Each annual issue, released in the fall, is published with simultaneous print and online versions. See the full version on our website at: https://manoa.hawaii.edu/horizons/

CALL FOR SUBMISSIONS

We invite students enrolled at UHM during the Spring 2022 through Spring 2024 semesters to submit work produced within this time frame to be considered for the Fall 2024 issue (Volume IX). We encourage submissions from any undergraduate academic discipline.

For specific deadlines and detailed instructions on how to submit works for consideration, please visit our website listed above.

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