Undergraduate Research and Creative Work

9 December 2016 – 8:45am to 1:30pm
Sakamaki Hall
Campus Center Ballroom
Honolulu, Hawaiʻi
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<td>8:45-9:20a</td>
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Sakamaki Hall
Oral Presentations Session One  9:35a - 10:30a
Oral Presentations Session Two  10:40a - 11:35a

A101  Engineering & Computer Sciences/
      Natural Sciences

A102  Arts & Humanities – Research/
      Arts & Humanities – Creative

A103  Social Sciences

B101  Natural Sciences

B102  Natural Sciences

B103  Natural Sciences

B104  Natural Sciences

Campus Center Ballroom
Poster Presentations  11:45a - 12:30p
Lunch and Awards Ceremony  12:30p - 1:30p
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| Sakamaki A101| Engineering & Computer Sciences | Stephanie Chang, Design of a Biological Filter for Carbon Dioxide Using *Chlorella vulgaris*
|              |                               | Hailing Li, Reliability of Punching Shear Strength Prediction for Existing Buildings |
|              |                               | Shelby Sullivan, Death Camp Commanders: Administrators of Hitler’s “Final Solution” |

* next to name in schedule indicates student is also presenting a poster
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| Sakamaki A103 | Social Sciences Finished Projects                  | Ksenia Bussard* Knowledge and Awareness of Human Papillomavirus (HPV) and HPV Vaccination Among College Students at the University of Hawai‘i at Mānoa: A Gender Comparison Study  
Stephanie Cacal* Kalusugan at Kayamanan (Health and Wealth) of Filipinos in Kalihi  
Kyung Moo Kim* Price Determinants of Tuberculosis Drugs |
| Sakamaki B101 | Natural Sciences Finished Projects                 | Eileen Chen, Nikki Rousslang Screening Mutant Human Asparaginase-Producing Escherichia coli for the Production of Highly Active Human Asparaginases  
Michelle Hu Optimizing Aromatase Expression and Uncovering Novel Allosteric Inhibitors  
Casie Kubota, Marissa Kuwabara Expression of STAT3 in E. coli for Small Molecule Inhibitor Development |

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| Sakamaki B102 | Natural Sciences Finished Projects                                    | Dalton Muchow: Raman and Fluorescence Spectroscopy for Categorizing Coral Health in Hawai‘i  
                  |                                                                       | Alaina Smith: Maintenance of Diversity Through Multiple Timescales of Variation  
                  |                                                                       | Rebecca Marie Weible: Method Development: Isolating Microplastics from Copepods in the Ala Wai Canal |
| Sakamaki B103 | Natural Sciences Finished Projects                                    | Jenny S Fang*: Design and Development of Plasmids Exressing Sex Chromosome Encoded Zfy/x Genes to Test Specificity of Newly Developed Antibodies against Mouse ZF Proteins  
                  |                                                                       | Stephen Macaspac: Determination of the Ligand-Binding Sites of GPCR’s through Protein Conservation Analysis and Docking Simulations |
|              |                                                                       | Cindy Vuong: Function of Mouse ORC4 Fragments in Female Meiosis          |

* next to name in schedule indicates student is also presenting a poster
### Oral Presentations Session One

**9:35 - 10:30a**

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<td>Leo V Louis</td>
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<td>Micah Pascual</td>
<td>Mechanisms Underlying Differential Responses to Neuropeptide Allatostatin-C (AST-C) in the Cardiac Ganglion (CG) of the American lobster, <em>Homarus americanus</em></td>
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<td>Taylor Tashiro</td>
<td>Molecular Taxonomic Identification of Nematode Species in Hawai’i</td>
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**10:40 - 11:35a**

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<td>Nicholas Kawelakai Farrant</td>
<td>Understanding the Community Food Movement on O‘ahu’s North Shore</td>
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<td>Shannon Noelle Rivera</td>
<td>Nowhere to Go: Perceived Barriers to the Use of Assisted Colonization for Climate Sensitive Species</td>
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<td>The Protective Effects of mTOR against Hypoxic Stressor in Cardiomyocytes</td>
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<td>Brennen Yasuda</td>
<td>Expression of Alternative Ribosomal Proteins in <em>Mycobacteria smegmatis</em> under Stress Conditions</td>
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<td>Nutrition &amp; Elemental Stoichiometry of Microzooplankton Life Stages in a Changing Climate</td>
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<td>Derek Risch</td>
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<td>Jason Dela Cruz</td>
<td>Large Scale Expression and Purification of Yop1 for in vitro Tubule Formation</td>
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<td>Christian Macaspac, Vania Fernandes</td>
<td>Vulnerability in the Developmental Regulation of the Mechansosensor in the Mexican Cavefish</td>
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<td>Crystal Valdez</td>
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<td>Zach Quinlan</td>
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Poster Presentations
11:45a - 12:30p - Campus Center Ballroom

Arts & Humanities

Amber O’Brien  
Energy Efficiency: The Future of Glass Making

Engineering & Computer Sciences

Derek Chan, Andrew Guagliardo, Anna Sikkink  
Translating Oral Traditions Into A Modern, Immersive, Interactive Virtual Reality Experience

Natural Sciences

Andrew Chang  
Chemical Characterization and Cellular Effect of ‘Uhaloa, a Native Hawaiian Medicinal Plant

Jenny S Fang  
Design and Development of Plasmids Expressing Sex Chromosome Encoded Zfy/x Genes to Test Specificity of Newly Developed Antibodies against Mouse ZF Proteins

Kimberly Kahaleua, Maria Petelo  
Epithelial Cell-specific Mechanisms of Capsaicin in a Native Hawaiian Medicinal Plant, Nīoi
Social Sciences

Ksenia Bussard  Knowledge and Awareness of Human Papillomavirus (HPV) and HPV Vaccination Among College Students at the University of Hawai‘i at Mānoa: A Gender Comparison Study

Stephanie Cacal  *Kalusugan at Kayamanan* (Health and Wealth) of Filipinos in Kalihi

Kyung Moo Kim  Price Determinants of Tuberculosis Drugs
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. The faculty mentor, if appropriate, is listed below the abstract.

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

**Derek Chan, Andrew Guagliardo, Anna Sikkink**

**Eileen Chen, Nikki Rousslang**

**Evan Fujimoto, Davis Wong**

**Kimberly Kahaleua, Maria Petelo**

**Casic Kubota, Marissa Kuwabara**

**Christian Macaspac, Vania Fernandes**

Abstracts are direct from presenters; wording and content are the author’s responsibility.
The Effects of Groundwater-Derived Nutrients on Macroalgal Growth

Recent evidence indicates that coastal ecosystems undergoing nutrient enrichment in areas of low circulation are susceptible to community composition shifts, algal blooms, declines in coral health and perseverance of invasive macroalgae. In order to determine whether groundwater-derived nutrients impact the growth of macroalgal species located within Maunalua Bay, the rates of nutrient delivery over time to different locations were determined, before correlations between macroalgal distribution and nutrient loads were investigated. Submarine groundwater discharge (SGD) is a source of high nutrients on Wailupe and Black Point reef flats. As SGD seeps out onto the reef flat, it is diluted as it mixes offshore. To investigate any correlations between macroalgal growth and groundwater factors (ie. high nutrients and low salinity), growth assays were conducted at Black Point and Wailupe in zones with various degrees of groundwater impact.

Compartmentalized mesh pouches, each containing a different macroalgal species, were deployed at 18 locations, spanning 3 zones from highest to lowest groundwater impact (spring, diffuse, and transition) over 5 days. These experiments were repeated 4 times at each site, providing reliable growth data with respect to groundwater influence. Different macroalgal species showed different growth rates, revealing that algae growth differed by both species and zone.

Mentor: Dr. Florence Thomas
Knowledge and Awareness of Human Papillomavirus (HPV) and HPV Vaccination Among College Students at the University of Hawai‘i at Mānoa: A Gender Comparison Study

Human Papillomavirus (HPV) is the most common sexually transmitted disease in the United States. Some strains of the virus can cause various cancers and can lead to genital warts in both males and females. There are three FDA-approved HPV vaccines that can prevent most of the HPV-caused cancers and genital warts. Nevertheless, the rate of their uptake is low in the nation and in Hawai‘i in particular.

This research project was designed to estimate the prevalence of HPV vaccination among college students at the University of Hawai‘i at Mānoa (UHM), to understand the possible reasons for not vaccinating, and to perform a gender comparison of HPV and HPV vaccine awareness among UHM students.

The study was designed as a self-administered cross-sectional survey. The study population consisted of 199 UH students 18 to 34 years of age. The survey included multiple-choice questions as well as true-or-false statements. The survey results showed that both male and female college students at UHM lacked in awareness and knowledge about HPV and HPV vaccines. However, male students lagged behind their female counterparts in knowledge about HPV and HPV vaccine and the vaccine uptake. The main reason for not getting vaccinated against HPV was identified as a lack of general knowledge and awareness about the HPV vaccines. Based on the survey results, public health officials should take measures to increase awareness about HPV and HPV vaccine among college students. These measures should focus on both male and female students to achieve vaccine’s intended public health benefits.

Mentor: Dr. Eric Hurwitz
Kalusugan at Kayamanan (Health and Wealth) of Filipinos in Kalihi

Filipinos in Hawaii have high rates of obesity, diabetes, hypertension, and the worst measures of behavioral risk factors like tobacco use and poor diet. To address these health issues and create a healthier community, culturally competent and relevant programs must be implemented. However, a healthier community cannot be achieved until health is defined. Each community owns different capitals/wealth, meaning they all have different definitions of health. This study aims to define health and non-monetized wealth of Filipinos in Kalihi.

This study worked with Kokua Kalihi Valley (KKV)’s Community Education - Civic Engagement (CECE) program. We conducted cultures circles with 52 Filipino residents of Kalihi between the ages of 18-24. In these culture circles, they answered four questions about health, wealth, healing, and their community. The results showed that definitions of health go beyond just that of the medical definition. Results also showed many different sources of wealth that can be found in the community; the highest being relationships between the people and community that surround them. This study created a framework with strategies and examples on how to approach different aspects of health defined by the community using their narratives and stories.

This study created a space and empowered the Filipino residents of Kalihi to find ways to make themselves healthier on their own terms. Through the framework, we hope to aid in developing better programs to improve the community’s health overall. This study also hopes to bring awareness about the relationship between health and non-monetized wealth.

Mentor: Dr. Jeffrey Acido
Virtual reality is an exciting medium that has unexplored potential for narrative storytelling. This creative project will result in an interactive VR experience, based on a Polynesian myth—a rarely investigated subject. We began by conducting extensive background research on Polynesian myths. We selected candidates based on an established criteria for an engaging VR experience. We chose the myth "How Maui Snared the Sun" because it provided a struggle against supernatural forces and required characters and interactions that would be impossible to recreate in traditional mediums. The next step was to begin to experiment with various ways to bring the story into the virtual realm and to adapt the story so that the user would feel that they had a role to play. We ended up with a framework of a series of possible interactions that would lead to a complete storyline. Not all of the interactions are required to complete the story, creating a unique experience, just as a traditionally told story may vary slightly in each telling. Initial interactions were programmed and tested in Unity3D using placeholder models. We built final models and animations in Maya using simplified mannequins for our human characters and more complex models and animations for the supernatural characters such as the Sun and Moon. Finally, ambient music, sound effects and voiceover was added to increase a sense of presence and create an additional layer of emotion.

Mentor: Dr. Jason Leigh
Chemical Characterization and Cellular Effect of ‘Uhaloa, a Native Hawaiian Medicinal Plant

‘Uhaloa (Waltheria indica) is an endemic species in Hawaii. A tea made from dried leaves, flowers and fresh tap root of ‘Uhaloa is used in La’au Lapa’au by Kahuna La’au Lapa’au (traditional Hawaii health practitioners) to treat sore throat, cough, congestion, arthritis, asthma, upper respiratory problems, and infant thrush. Chemical compounds of ‘Uhaloa include flavonoids and other chemical compounds. Quercetin is a flavonoid in ‘Uhaloa with known antibacterial and anti-inflammatory properties. In understanding the basis for la’au lapa’au applications, involved cultivating ‘Uhaloa, in soil and hydroponics with the later showing significantly higher growth rates, to provide sufficient material for the study. We have subsequently undertaken the analysis of the known effective compounds that may be responsible for the multiple healing properties of ‘Uhaloa. Using extracts derived from the dried leaves of the cultured plant, we performed chemical and biological analyses. Quercetin was detected in initial samples from a modified Rao’s procedure using hexane-acetone-chloroform or ethanol-hexane extract by thin layer chromatography (TLC). High performance liquid chromatography (HPLC) pilot analyses of crude ethanol extracts were conducted to identify compounds with potential biological activities. In bactericidal assays the ethanol-hexane fraction, hypothesized to contain multiple flavonoids, showed slightly greater antibacterial effect against Staphylococcus aureus than the hexane-acetone-chloroform extract or quercetin. Cell-based assays in cultured epithelial cells and monocytes are aimed at identifying inflammatory mediators potentially modified by ‘Uhaloa extracts, a mechanism that may serve as the basis for its valuable medicinal properties.

Mentor: Dr. Katalin Csizsar
Design of a Biological Filter for Carbon Dioxide Using *Chlorella vulgaris*

Atmospheric carbon dioxide has been increasing due to many causes such as the use of fossil fuels. Since it is a greenhouse gas, it is necessary that the levels are reduced. Carbon dioxide is used naturally by photosynthetic organisms such as algae. The usage can vary based on the algae’s ability to access nutrients and the form of the carbon dioxide. Therefore, the purpose of the project was to test different methods of growing algae to determine the best method for carbon dioxide removal.

The algae used was *Chlorella vulgaris* because it is easy to cultivate and has many uses such as a nutritional supplement and a possible biofuel. *C. vulgaris* was grown using three different methods. First, the algae were spread on a sheet of filter paper and had the growth media dripped onto the paper. Next, the algae were grown suspended in the liquid growth media. In the last method, the algae were cultivated on the growth media solidified using agar.

Mentor: Dr. Wei-Wen Su
Screening Mutant Human Asparaginase-Producing Escherichia coli for the Production of Highly Active Human Asparaginases

Current treatment for Acute Lymphoblastic Leukemia (ALL) includes the usage of drugs derived from bacterial asparaginase (ASNase). ASNase is an enzyme that breaks up asparagine, a nonessential amino acid for humans but essential amino acid for cancerous lymphoblasts. Unfortunately, some patients experience mild to fatal allergic reactions to the drug due to its derivation from bacteria. Human ASNase (hASNase) drugs may have the potential to displace the bacterial ASNase drugs. Because hASNases are not foreign to human bodies, they should not trigger allergic reactions like bacterial ASNases do. However, hASNase is significantly less active than the bacterial ASNase. Therefore, our goal was to obtain a more active hASNase by introducing mutations into the hASNase gene. We screened these mutants using a pH-sensitive assay and isolated mutants with increased activity. Then, we developed protocols for expression and purification to extract active hASNase. Our future goal is to obtain a hASNase mutant that is at least twice as active as the original hASNase. All our research took place in Dr. Ho Ng’s protein structure laboratory.

Mentor: Dr. Ho Leung Ng
Mental Health Stigma Perceived by Rural Health Professionals

To investigate mental health stigma, this study focuses on rural and Native Hawaiian communities across the State of Hawai`i.

Confronting mental health stigma is vital to improving health services. Research has identified mental health stigma is a barrier to accessing health services and a higher prevalence of mental health stigma in rural communities. Finally, the majority of Native Hawaiians reside in rural communities, where health resources tend to be limited.

An online survey has been designed to assess the extent to which health professionals working in and/or with rural and Native Hawaiian communities participate in the Department of Psychiatry (DoP) continuing education activities. The current honors project enhanced the survey by adding six mental health stigma items in effort to identify mental health stigma as perceived by rural health professionals. Data collection will be coordinated under the supervision of DoP continuing education board member. Local professional associations will be contacted to gain permission to distribute the survey via respective listservs.

Data will be analyzed based on professional context (working in rural, Native Hawaiian community; professional affiliation) using SPSS software, with reports of descriptive statistics. It is expected that professionals working in and/or with rural and Native Hawai`ian communities will rate perceived mental health stigma higher than professionals working in other communities.

Continuing education may be facilitated by the DoP to enhance rural health access through professional development. Future research should seek to assess the efficacy of the DoP’s continuing education activities in reducing mental health stigma among health professionals.

Mentor: Dr. Susana Helm
Large Scale Expression and Purification of Yop1 for in vitro Tubule Formation

One of the most interesting aspects of the Endoplasmic Reticulum within eukaryotic cells is its ability to create a vast network of peripheral microtubules throughout a cell. This network allows the Endoplasmic Reticulum to facilitate lipid transfer and calcium signaling between local organelles. This network would not be possible without the presence of Yop1, a membrane-bound protein that helps form the microtubule structure. The overarching goal of this project is to optimize Escherichia coli’s expression of the Yop1 protein, test the protein’s functionality, and crystallize the protein in order to elucidate its structure. As of now, I’m still working on optimizing the expression protocol to yield higher levels of functional protein. This process includes varying the growing conditions of the cell cultures and using different Yop1 constructs and expression schemes set by Brady et. al. Yop1 plays a key role in maintaining the morphology of the peripheral endoplasmic reticulum, which is important for higher eukaryotic organisms. By understanding its structure, we can use the information to learn more about the protein itself as well as neurological disorders associated with endoplasmic reticulum stress including Alzheimer's disease and Crohn’s disease.

Mentor: Dr. Ho Leung Ng
Heritability of Coral pH Tolerance

Coral reefs are some of the most biologically diverse ecosystems on Earth, but are threatened as anthropogenic (man-made) carbon dioxide emissions lower the pH of the ocean. This process, known as ocean acidification (OA), is expected to reduce coral growth rates. Heritable variation underlies the potential for evolution over time, but the degree of variation in pH tolerances among corals, as well as the heritability of any such variation, had not yet been studied. This study quantifies the variation in coral calcification tolerances to OA and the heritability of any such variation among the eight dominant coral species found around the island of O’ahu, constituting >97% coral cover on Hawaiian reefs.

Coral colonies were sampled across natural gradients in seawater chemistry from six different locations around O’ahu, Hawai’i. The experiment was conducted at the Hawai’i Institute of Marine Biology in Kane’ohe, O’ahu. Six 3 to 5 centimeter samples, called nubbins, were cut from each parent coral and placed in four outdoor, flow-through 300L mesocosm tanks, totaling 160 nubbins per tank. Two of the four tanks were randomly chosen to receive carbon dioxide dosing (pH~7.6) and two were kept at ambient seawater pH (pH~8.0) for the six-week experiment.

Species *Montipora patula*, *Porites evermanni*, and *Porites meandrina* displayed strongly heritable calcification rates and varied significantly in responses between colonies. As coral reefs serve as the basis of vast ecosystems, the identification of species that may adapt as the ocean acidifies is a significant first step in planning for the future.

Mentor: Dr. Rob Toonen
Development of Men's Fashion in the USA

Fashion is a never-ending update of previous designs. For the menswear market, tailoring was lost over time after the 1960s and is currently regaining momentum in this modern generation. The exponential growth of interest in men’s fashion within the industry is recognized nationally. This involves challenging the accepted aesthetics of masculinity and breaking gender-fixed clothing silhouettes.

Street style is an eccentric expression of contemporary culture in fashion. It has become a resource that inspires designers’ collections. Hawai‘i is one of the most recognizable travel destinations globally, which brings different cultures into one location. The combination of cultures in one place allows an array of diversity that can be seen on the streets of Honolulu. These are documented in “Honolulu Street Style” by Maile Moran, Attila Pohlmann, and Andy Reilly.

This creative project focuses on developing a fashion line for the contemporary menswear market by combining the aesthetics of classic gentlemen’s wear with the diversity found in street style in Hawai‘i.

Mentor: Dr. Andy Reilly
Design and Development of Plasmids Expressing Sex Chromosome Encoded 
Zfy/x Genes to Test Specificity of Newly Developed Antibodies Against 
Mouse ZF Proteins

In mice, two crucial Y-linked genes were identified, Sry driving formation of 
testes and Eif2s3y responsible for initiation of spermatogenesis. Male mice 
with Y chromosome contribution provided by these two genes produced 
haploid round spermatids, which after injection into the oocytes yielded 
offspring. These round spermatids represented immature male gametes as 
they lacked tails and were not able to fertilize on their own. When a third 
gene Y-gene, Zfy2, was added to males carrying Sry and Eif2s3y, sperm with 
tails were formed. Zfy2 is therefore a crucial gene for male reproduction in 
the mouse, but nothing is known about the mechanism or molecular 
function of its action. The first step to uncover this requires creating 
experimental tools. The goal of my project is to identify an antibody that can 
recognize ZFY2 from its X-linked homologue ZFX and Y-linked ZFY1, both of 
which are very similar. To fulfill this, I will produce plasmids that will be used 
for transfection of Human Embryonic Kidney (HEK) cells in order to make 
them translate each ZFX/Y proteins. These transgenic HEK cells will then be 
used to test the specificity of the anti-ZFY2 antibodies (which we are 
currently developing) using dot blots, western blots, and immunofluorescence. The importance of this work is that it will allow 
identification of the best ZFY2-specific antibody for future investigations of 
the functional role of ZFY2 in sperm maturation. Since Zfy2 is an important 
male fertility gene, the study bears relevance to understanding and 
treatment of human male infertility.

Mentor: Monika Ward
Understanding the Community Food Movement on O‘ahu’s North Shore

Recognizing opportunities to improve public health, promote regional food security, and protect agricultural land, community leaders of O‘ahu’s North Shore organized the First Annual North Shore Food Summit (NSFS) in 2013. In its four-year tenure since that inaugural event, the NSFS has explored the connections that the North Shore food system, including community health, Kanaka ʻŌiwi (indigenous Hawaiian) culture, local and community-based energy production, water issues, and land conservation. These conversations have been facilitated through a wide variety of contexts, including presentations and panel discussions, collaborative breakout sessions, site visits, and youth involvement.

This research involved the compilation and analysis of existing qualitative data recorded throughout planning and implementation of the four North Shore Food Summit events to date. It also included gathering and analyzing the reflections of prominent NSFS participants and planners on their experiences with and hopes for the annual event. Lastly, it draws upon other examples from other communities to place the NSFS within the context of the contemporary movement for food reform throughout Hawai‘i and the World.

Conclusions drawn from these data not only serve as a guide for North Shore community members’ continued efforts, but also as a record of this movement to inform and inspire other communities involved in similar efforts.

Mentor: Dr. Noelani Goodyear-Kaʻōpua
The Protective Effects of mTOR against Hypoxic Stressor in Cardiomyocytes

Heart failure is a major cause of death worldwide and results from cardiomyocyte (CM) injury caused by ischemic events. Ischemia-reperfusion (I/R) injury is a major pathophysiological feature seen in clinical practice because of reperfusion therapies. I/R injury generates reactive oxygen species (ROS) released from mitochondria, thus leading to cell death. Previously we reported that mTOR (mammalian target of rapamycin) protects the heart against I/R injury in both in vivo and ex vivo animal models. However, the role of mTOR in CMs is poorly understood. In this study, we subjected H9c2 cardiomyoblasts to hydrogen peroxide (H$_2$O$_2$)-induced ischemia in vitro to study the role of mTOR in I/R injury. H$_2$O$_2$ is a well-known ROS that increases in I/R injury. Wildtype H9c2 and mTOR stable-cell lines were cultured in 500 μM H$_2$O$_2$ for 30 minutes, and cell death was analyzed using a Live/Dead Cell Viability Assay (Invitrogen). We used fluorescence microscopy to photograph three random areas in each well. We counted viable and dead cells, which showed a decrease in cell death in cells with mTOR overexpression compared to the wildtype (controls vs. mTOR; 11.1±2.4 % vs. 2.3±0.3%, p<0.05, n=3 each). The result of this experiment is further evidence for the protective effects of mTOR in cardiomyocytes. Understanding the cardioprotective effects of mTOR could lead to new therapies for heart failure.

Mentor: Dr. Takashi Matsui
Optimizing Aromatase Expression and Uncovering Novel Allosteric Inhibitors

Breast cancer occurs in 1 out of 8 women while 2,600 new cases of breast cancer are expected for men in 2016 alone\(^1\). Aromatase, a cytochrome P450 enzyme that converts androgens, is linked to hormonal breast cancer development\(^2\). Aromatase inhibitors are currently used to treat breast cancer, but the method of binding for some of them remains unknown. The objective of this project is to optimize aromatase expression in \textit{E. coli} and uncover novel allosteric inhibitors. While screening possible compounds using an inhibition assay, AR11 and AR13 produced IC\(_{50}\) values of 25.35 $\mu$M and 0.41 $\mu$M respectively, compared to known inhibitors ketoconazole and endoxifen. Expression of mutant-type aromatase was not increased, despite adjusting induction time, incubation temperature, and cell strain. Though optimization of aromatase was not achieved, possible inhibitors were uncovered which will be used in future crystallization screening once expression is improved on. These crystal screens can then be used to create new structures for aromatase, leading to improved inhibitor potency and reduced toxicity.

Mentor: Dr. Ho Leung Ng
Epithelial Cell-specific Mechanisms of Capsaicin in a Native Hawaiian Medicinal Plant, Nīoi

Nīoi (Capsicum frutescens), has been used by traditional Hawaiian health practitioners to treat aches and pains, arthritis, rheumatism and skin conditions. One of its components, capsaicin, topically reduces pain and symptoms associated with inflammation, a common feature in skin disorders including psoriasis, atopic dermatitis, and eczema with high prevalence in Native Hawaiian populations. Immune responses and expression of pro-inflammatory cytokines are also suppressed by capsaicin. While an early inflammatory phase is prominent during skin wound healing, controversial results were reported for capsaicin treatment involving slow healing, delayed wound contraction, and hypertrophic scars, demonstrating strong effect on skin epithelial cell functions. However, epithelia-associated mechanisms and responses to capsaicin remain undocumented.

We have evaluated capsaicin-induced changes in a secondary analysis of DNA array data of gene expression in epi-4 human epithelial cells, and downstream effects on the migration, proliferation and adhesion of embryonic kidney cells (HEK293) and epidermal keratinocytes (HEKa). Gene expression data revealed capsaicin-altered gene expression of growth factors and their receptors; of cell-cell interactions; of genes responsible for remodeling the cellular microenvironment; and of those encoding components of the basal lamina that determines epithelial functions. Downstream phenotype effects included a tendency for reduced migration and a significant decrease in cell proliferation of capsaicin treated HEKa keratinocytes, but not HEK239 cells. Both array data and cell phenotype changes indicated altered cell adhesion. Collectively, results demonstrate that capsaicin has strong, but differential effects on epithelial cell types highly relevant to its topical applications.

Co-Authors: Andrew Chang, Noemi Polgar, Rozalia Lackzo, Ben Fogelgren
Mentor: Dr. Katalin Csiszar
Thieving Stars Caught by Kepler: A Search for Intermittent Accretors in Kepler Binary Systems

Binary stars, under certain circumstances, have a possibility of forming a symbiotic binary star system---a phenomenon where one star begins to devour its companion. These systems can be detected using three methods: studying light curves for intermittent brightening, intermittent dimming and orbital period decay. By re-purposing data from the Kepler telescope and taking near-infrared photometry using the Faulkes telescope, potential symbiotic binary star systems have been detected. Follow up observations of these potential accretors will be carried out next summer.

Mentor: Dr. Roberto Mendez
Price Determinants of Tuberculosis Drugs

Though drugs for tuberculosis has existed since the 1940s, over 9.6 million people fell ill with TB and 1.5 million died from disease in 2014. Developing countries carry much of the burden: over 95% of TB deaths occur in low- and middle-income countries, accounting for more than 80% of new tuberculosis cases globally every year. It is therefore important that tuberculosis drugs are available and affordable to countries that are not adept at negotiation and/or procurement. The Price and Quality Reporting (PQR) system is a web-based system that collects procurement data for select commodities under The Global Fund to Fight AIDS, Tuberculosis and Malaria. Little empirical work has been done on factors that affect global tuberculosis drug pricing and affordability. A data set containing PQR information from 2006 to 2014 was obtained from the Global Fund. We isolated procurement data related to tuberculosis and its treatment. There were 6372 transactions and the products purchased amount to more than US$400 million (current terms). We analyze using regression analysis the relationship between prices and factors including time intervals between purchase order date and delivery date, FDCs, GDP per capita (Atlas method), public health expenditure as % of GDP, population density, education rates, government corruption, incidence of tuberculosis, suppliers, geography, and infrastructure (% roads paved). Preliminary results suggest positive correlations of price with increases in public healthcare expenditure, GDP per capita (current US$), population density, CPIA scores, incidence of tuberculosis, and urban population.

Mentor: Dr. Victoria Fan
Expression of STAT3 in *E. coli* for Small Molecule Inhibitor Development

Abnormal function and activation of STAT3, a protein in humans that assists in cell proliferation and survival, is manifested in many human diseases such as cancer. We are interested in producing high resolution visualizations of crystallized STAT3 proteins that are bound to an inhibitor. Currently, there are a surplus of inhibitors that bind to STAT3, but none bind strongly enough to make that inhibitor a viable option for medical treatment. Due to the fact that the crystal structure of a STAT3 protein binding to a ligand is not known, scientists are unable to move forward in cancer therapy research. The goal of this project was to crystallize two different variants of the STAT3 protein that is bound to various ligands in hopes to give researchers powerful data that could possibly lead to a breakthrough in cancer treatment. In order to do this, STAT3 was expressed in *E. coli* cells and then collected and purified. The purified protein was then incubated in crystallization trays containing various solutions in an effort to produce viable crystals. Using these methods, STAT3 crystals were successfully grown in MCSG-2 and MCSG-4 crystallization trays. It was also found that Arginine greatly increased the stability of STAT3 when used in the purification process. The crystals will be soaked in various ligands in attempt to bind the ligands to the crystals. A follow-up project is currently under way to obtain diffraction data on the crystals in order to produce a protein structure using digital software.

Mentor: Dr. Ho Leung Ng
Reliability of Punching Shear Strength Prediction for Existing Buildings

The punching shear strength of steel-reinforced concrete slab-column connections in existing buildings has been the source of many catastrophic failures during earthquakes and accidental overload of buildings. When old buildings are analyzed using the current formulas prescribed by the American Concrete Institute (ACI) Building Code Requirements (ACI 318-14) engineers concludes that the strength is insufficient and repairs are needed even if the structure has been performing adequately for decades. To better predict the strength of these connections, the reliability of historical ACI punching shear models (PSM), from 1912, through today's code can be evaluated. A reliability model must consider both the variability in demand and capacity.

PSMs are used to predict the capacity of these connections; however the actual strength is influenced by variability in geometry, material properties as well as how accurate the model represents reality when compared to experimental data. Monte Carlo Simulation (MCS) was used to evaluate how well the historical PSMs were able to predict the actual strength of connections determined by 522 experiments available in the literature. A professional factor, the mean ratio of the actual failure load to predicted capacity, was determined for each PSM.

The professional factor, MCS, and a realistic statistical variation of loads were then used to develop an initial estimate of reliability for each PSM. A typical slab column connection designed such that the demand perfectly matched the nominal capacity predicted by the PSM was used for this analysis. Preliminary estimates of reliability for each PSM will be presented.

Mentor: Dr. Gaur Johnson
Market Survey of Fungi in Bhutan

The Kingdom of Bhutan is a relatively small yet culturally and biologically rich mountainous landlocked country to the north of India. Elevations range from 200–7500 meters and includes sub-tropical, alpine, and temperate zones. Bhutan is made up of 20 dzongkhags (districts), and there are 23 spoken languages. More than 69% of the population live in rural communities where edible wild plants (EWP) contribute to a large portion of household annual income. In particular, harvested mushrooms are extremely important, in some cases contributing up to 70% of the annual income for some community members. Despite their obvious value both economically and as a food source, limited work has been done to assess the ecological and social implications of harvest. Here I present the results from market surveys conducted in three districts in western Bhutan. The goal of these surveys was to investigate the diversity and relative quantity of mushrooms being harvested for sale. As well as local ecological knowledge related to the harvest of mushrooms. Preliminary results reveal both a large diversity of mushrooms being sold, and a relatively sophisticated understanding of mushroom ecology among some community members. However, some Bhutanese people have expressed concern that competition amongst harvesters is leading to a decline in mushroom size and quality. For instance *Cantharellus cibarius*, considered a favorite amongst many Bhutanese, is exposed to large harvesting pressures that have resulted in a noticeable decline in size and quality in markets. These issues draw into question the ecological and social implications of mushroom harvesting.

Mentor: Michael B. Thomas
Vulnerability in the Developmental Regulation of the MechanoSensor in the Mexican Cavefish

Stability of the developmental process is key in maintaining an ‘adapted’ species in a given environment, whereas it could reduce a chance to adapt to the novel environment. The Mexican tetra, Astyanax mexicanus, is composed of two morphs; the cave dwelling and surface dwelling forms, which have both evolved from the surface dwelling ancestor millions of years ago. Through evolution in the perpetual dark and food sparse cave, cavefish show a larger number of the mechanosensory superficial neuromasts than that of the surface fish, which are the sensor for a cave-adapted foraging behavior, rheotaxis and schooling. To test the developmental robustness of this sensor, we pharmacologically inhibited the endothelin signaling, which perturbs the cranial bone formation, thus, indirectly inducing more number of superficial neuromasts. After 5 times of repeated experiments, we found that the neuromast number significantly increased more in cavefish than in surface fish, suggesting that the cavefish may have evolved a developmental flexibility in mechanosensor in order to adapt to the novel environment. We are further exploring the developmental process of this sensor and the relationship with its adaptive foraging behaviors.

Mentor, Co-Author: Dr. Masato Yoshizawa
Stephen Macaspac  
Biology  
Finished Project in Natural Sciences  
Participation for UROP  
Oral Presentation: Session 1 (9:35-10:30a) in Sakamaki B103

**Determination of the Ligand-Binding Sites of GPCR’s through Protein Conservation Analysis and Docking Simulations**

G-protein coupled receptors (GPCRs) are known to be involved in various physiological functions. Once ligand-binding sites are identified, pharmaceutical interactions can be further studied and applied to the profusion of GPCR-related disorders such as hormone-induced cancers. The crystal structures of most GPCR’s have not been determined, and the binding sites of most ligands have not yet been experimentally identified. Various computational approaches have been used to predict ligand-binding sites in GPCRs. Traditionally, docking methods have been utilized to compute the lowest energy orientation of a ligand fit to a receptor surface. Another feature that can be used is protein conservation because ligand-binding sites of proteins are usually conserved. We applied a hybrid scoring function, using information from ligand docking and protein conservation, to predict binding sites on sites on a G-protein coupled estrogen receptor (GPER). Crystal structures of the a2a adenosine receptor and beta-2 adrenergic receptor have been determined. Because their structures have been experimentally isolated with their ligands, they can serve as models to ascertain the accuracy of the hybrid scoring function employed to GPER. The coordinates for the crystal structures a2a adenosine receptor bound by adenosine and beta-2 adrenergic receptor bound by epinephrine were acquired from RCSB protein databank and uploaded to chimera. Each receptor was screened for amino acids interacting with their respective ligands. These residues served as a benchmark for comparison with predictions. Predicted binding sites parallel benchmark residues and verify the potency of a hybrid scoring function that can be extrapolated to additional GPCRs.

Mentor: Dr. Ho Leung Ng
Copepods, highly abundant microzooplankton, generally have rigid metabolic needs, and must adjust their feeding behavior and/or metabolic rates in order to compensate for imbalances in food stoichiometry. As copepods develop through a lifecycle, their demand for limiting nutrients, such as phosphorus, shifts; the highest phosphorus demand occurring during the naupliar stages. Measurements of specific zooplankton biomass, grazing rates, and internal stoichiometry are sampled throughout one copepod life cycle from nauplii to adult in order to assess how reduction in relative phosphorous content of a phytoplankton food source will affect a small copepod species, *Parvocalanus crassirostrus*, at different development stages. In addition, to simulate variable sea surface temperature around Hawaii, the same experiment is conducted at three different controlled temperatures: 25°C (mean winter temperature), 28°C, and 32°C. Significant differences across food treatment as well as temperature were observed for specific *P. crassirostrus* biomass for copepodites, while nauplii indicated a stronger resilience to both temperature and food treatment. This data will be presented along with *P. crassirostrus* grazing rates and carbon: phosphorous elemental stoichiometric data of both *P. crassirostrus* and the *Tisochrysis lutea* food source for all food treatments and temperature incubations. Knowledge of copepod nutrition and subsequent health as the planet warms and sea surface temperatures rise is important to the ability of tracking the effects climate change on biological life and will create a basis that could lead to a warning system for fishery crashes and dangerous marine anoxic zones.

Mentors: Dr. Craig Nelson, Dr. Carolyn Faithfull
Raman and Fluorescence Spectroscopy for Categorizing Coral Health in Hawai’i

The majority of the world’s reef ecosystems are at risk due to changes in the local and global environments. Many common current techniques that determine coral health over large areas require scientists to SCUBA dive on a coral reef to make observations and collect samples, requiring an enormous amount of planning and funding. Remote Raman spectroscopy is a powerful technique capable of quickly identifying a large variety of chemicals, including pure elements, simple molecules, inorganic chemicals, organic compounds, biogenic compounds, and rock forming minerals (calcite, aragonite) from any state of aggregation (solid, liquid, and gas phase). Another powerful remote sensing technique is “Time Resolved Laser Induced Native Fluorescence” (TR-LINF) and has been used as a standoff biofinder capable of differentiating between mineral and biological fluorescence. Both of these techniques are fast (detection time <0.1s) and can quickly and accurately measure large areas of interest. Remote Raman and TR-LINF’s proven use in categorizing biological markers at remote distance provides potential for application in measuring and categorizing large areas of coral reef health from a distance. Currently, nobody in Hawaii has the capability to remotely measure coral and assess its health using remote spectroscopy under daylight conditions.

Mentor: Dr. Anupam Misra
Energy Efficiency: The Future of Glass Making

Innovation and invention have been a hallmark of individual artists to improve glass making technology since the beginning of the studio glass movement. Studio operations and equipment are complicated and require skillful technical maintenance, financial literacy, and access to energy producing natural resources. Energy consumption, policy and funding of glass art studios and their use of material resources are areas of discussion that should be viewed through a positive lens. The purpose of this project was to encourage the conversation of energy efficiency in the glass community and establish a network of resources to actualize future research and promote sustainable glass making practices. The methods of research involved gathering qualitative data through surveys of publications, lectures, interviews, and observations from the Glass Art Society Conference and various studio visits around the country. The results have been centralized into a comprehensive database, www.GlassArtEnergy.org, which is easy to use and will be continuously updated as the conversation continues. The conclusion is that energy efficiency in the glass studio relies on mindful practices of the user and the awareness of available technologies combined with the responsibility to apply them. This project has been able to gather primary resources and make them an accessible educational resource. This platform has the potential to decrease the energy expenditure of the glass making community as a whole and progress us towards a more sustainable future.

Mentor: Rick Mills
Mechanisms Underlying Differential Responses to Neuropeptide Allatostatin-C (AST-C) in the Cardiac Ganglion (CG) of the American Lobster, *Homarus americanus*

Peptides are important modulators of neural circuit activity. In central pattern generator (CPG)-effector systems, peptides allow for flexibility in rhythmic motor output. In the lobster, *Homarus americanus*, the cardiac neuromuscular system, which consists of the cardiac ganglion (CG) and cardiac muscle (CM), controls the rhythmic motor output of the heart. Recent investigations of the actions of the peptide hormone allatostatin-C (AST-C) on the cardiac neuromuscular system have shown variability in physiological response among lobsters. Specifically, perfusion of AST-C through the semi-intact heart consistently decreased the frequency of ongoing heart contractions, but showed varied effects on contraction amplitude, decreasing it in some lobsters and increasing it in others. Our working hypothesis is that the different responses of the lobster cardiac neural circuit to AST-C are due to the types of AST-C receptors present in the CG in preparations that respond to AST-C with increases vs. decreases in contraction amplitude. As a first step in testing our hypothesis we generated tissue specific transcriptomes for the lobster (brain, eyestalk ganglia and CG) and have mined them using homology-based BLAST searches for transcripts encoding putative AST-C receptors. Via these analyses, four different AST-C receptor types were identified. We are now working to generate several additional transcriptomes (i.e., one from CGs that show increases in contraction amplitude and one from CGs that show decreases in contraction amplitude) to determine if there are differences in the relative abundance of the receptor types in animals with different physiological responses to AST-C.

Mentor: Andrew E Christie
Fluorescence of Dissolved Organic Matter of Coral Exudates

Benthic organisms in tropical reef ecosystems all exude dissolved organic matter as a portion of their primary production. Understanding the composition of these exudates as well as the response to changing environmental conditions is essential to understanding the metabolisms of these organisms. We collected in-situ filtrate during a multi week survey from corals for the detection of organic exudates. We analyzed the filtrate using fluorescence spectroscopy to characterize the exudate composition and differential exudate concentrations across multiple response variables. Exudates were collected from three species of coral; *Pocillopora damicornis*, *Porites compressa*, *Montipora capitata*, and across multiple patch reefs within Kaneohe bay. Using previously catalogued fluorescent dissolved organic matter (fDOM) exudate markers for coral exudation we determined the distance from the coral in which these exudate signatures disappeared due to dispersion. The coral colonies were selected from cloned individuals which displayed differential thermal tolerance and bleaching during past bleaching events. Although in-vitro measurements of proteinaceous fDOM showed high exudation of specific aromatic amino acid-like compounds, in-situ coral species were found to exude different proportions of these proteinaceous exudates dependent on species and location.

Mentor: Dr. Craig E Nelson
A Musical Journey - National Competition and Summer Festivals

The culminating piece of my project was an hour long solo piano recital that raised money for the Hawaii Piano Teacher’s Association. I presented works of various styles from Johann Sebastian Bach (1685-1750) to Avner Dorman (1975-present). I studied the repertoire presented at this recital with world renowned teachers at the prestigious Banff festival in Alberta, Canada, which the Undergraduate Research Opportunities Program (UROP) funded for me. I presented this recital because it shows the range of styles that I can perform, and I wanted to give back to the musical community that helped raise me into the musician I am today.

My project deals with the creative process, and finding an original and appealing voice despite playing from the same score as everyone else. How do I make the music leap off the page, what is stylistically correct, and how do I personalize the piece to my interpretation of the score without deviating from the composer’s wishes? These questions will be answered in my presentation.

In my musical studies, I’ve always had the help of my instructors, and they’ve guided me towards independence and musical maturity. The fruits of their labor show in my winning third place in a national competition and attending the Banff summer festival, of which 30 out of 200 applicants were accepted.

Mentor: Dr. Thomas Yee
Conversion of Food Waste to Renewable Biogas and Nutrient-Rich Bioslurry

Food waste from the University of Hawai`i at Mānoa (UHM) campus center cafeteria was converted to renewable energy and nutrient-rich effluent (bioslurry) through anaerobic digestion. Biochemical methane potential (BMP) tests were performed utilizing three food waste to inoculum ratios (i.e. 3:1, 2:1, and 1:1 volatile solid basis). Subsequently, this study tested the effectiveness of the bioslurry produced during anaerobic digestion as a soil amendment was also studied. The plant used in the pot experiment was *Brassica Juncea* (Baby Kai Choy). The pot experiment consisted of two slurry dosages i.e. with 200 mg of N and 400 mg of N per kg of soil. Another treatment was added with 400 mg of N of a commercial fertilizer, and a control treatment without a soil amendment. Effluent from the batch with the highest methane yield was added in intervals for 5 weeks to meet the Nitrogen content goal of the slurry treatments. The results revealed that the batch with the smallest amount of added food waste (i.e. 1:1) showed the highest methane yield. However, increasing food waste to inoculum ratio could significantly decrease methane yield. The inappropriate carbon to nitrogen ratio of the batch with high food waste to inoculum ratio (i.e. 2:1 and 3:1) could explain this phenomenon. The pot experiment concluded that the treatment added with 400 mg of N from the slurry produced the healthiest, densest, and most nutrient rich plants in comparison to a widely used commercial fertilizer.

Mentors: Dr. Jonathan Deenik, Dr. Samir Khanal
Impacts of Flood Control Management on Water Quality of Kaelepulu and Kawainui Streams in Kailua Bay

Coastal development and urbanization negatively impact water quality and alter the movement of freshwater. Management actions such as stream channelization accelerate the delivery of freshwater, along with dissolved nutrients and sediments, to marine ecosystems. The purpose of this study was to compare the impacts of rainfall events on water quality metrics in two adjacent human-modified stream systems that discharge to the ocean. Kawainui stream receives surface water from the Maunawili watershed, while Kaelepulu stream is largely cut off from the watershed due to a barrier built by the Army Corps of Engineers. Four sampling stations were established in each stream, arranged linearly from the mouth of the stream toward the interior of the wetland. Sampling was conducted monthly from May to August 2016 on the highest tide, as a baseline, and when rainfall measured in the Maunawili watershed exceeded 2.7cm. Water quality data (salinity, pH, dissolved oxygen (DO), turbidity) were collected using a YSI ProPlus multiparameter instrument. Surface water was collected at each station and is currently being analyzed for dissolved inorganic nutrients ($\text{NO}_3^-$ + $\text{NO}_2^-$, $\text{PO}_4^{3-}$, $\text{NH}_4^+$, $\text{H}_4\text{SiO}_4$). Preliminary data from the YSI instrument show a large difference in the response of the two streams to storm events. Salinity, pH, and DO were relatively unchanged following the largest storm in the Kaelepulu stream system, while the same storm caused a substantial change across all parameters within the Kawainui stream. A similar trend is expected for inorganic nutrient concentrations with higher concentrations in Kawainui due to runoff in the watershed.

Mentor: Dr. Melissa R Price
Nowhere to Go: Perceived Barriers to the Use of Assisted Colonization for Climate Sensitive Species

The Hawaiian Islands, as the planet’s most remote archipelago, are home to an array of species that are as vulnerable as they are unique. With the highest rate of extinction per square mile on earth, timely and effective actions must be taken to counter the additional pressure placed by climate change on the 400 species in Hawai’i listed as Endangered. Assisted colonization, the intentional movement and release of an organism outside its historical range, is one management option for species predicted to lack suitable habitat under likely climate change scenarios. With a focus on cases where such an extreme action may provide a reasonable hedge against extinction, first person interviews with employees of federal, state and non-profit agencies were used to evaluate both the perceived and existing obstacles to the use of assisted colonization. We found several potential barriers to utilization of this management tool. Assisted Colonization is considered by many to be high-risk, due to factors such as the cost of preparing the target habitat, and potentially high mortality in translocated individuals. Our results suggest that, despite existing policies that allow for assisted colonization in cases where it is warranted, this action is rarely considered. Since assisted colonization is best carried out when populations are robust enough to tolerate the removal of individuals for translocation, we recommend that this management action must be considered in conservation planning for species projected to have little or no suitable habitat remaining as climate change progresses.

Mentor: Dr. Melissa R Price
Maintenance of Diversity Through Multiple Timescales of Variation

Diversity can be maintained through resource fluctuation because species can evolve different strategies to thrive under different conditions. These strategies include being able to grow the fastest, being able to store the most resources, or being able to use resources more efficiently, thus being the best competitor under limited resources. Nutrient supply in the ocean likely varies over multiple time scales (e.g., seasonal variation vs. storms); however, we do not understand how multiple frequencies of variation affects phytoplankton communities. To test the role of multiple frequencies of variation, I am using a model describing how phytoplankton respond to varying nutrient supply. I compared how the community structure during conditions where there were two pulse frequencies differ from communities under one pulse frequency conditions.

Under one pulse conditions it was reiterated that species with different strategies did better under competition at different periods. As the pulse periods increased there were clear shifts in the community structure with respect to the strategies. However, when a second pulse frequency was added, pulse periods where species with one strategy usually dominated, were found to contain a co-existence between species with multiple strategies. In short, it was found that multiple frequencies of resource variation allow for a greater diversity of strategies present in the community. Understanding the maintenance of diversity in phytoplankton is important because they are the base of the food web and they play a major part in biogeochemical cycles including the carbon cycle, which affects how the biosphere reacts to climate change.

Mentor: Dr. Kyle Edwards
Death Camp Commanders: Administrators of Hitler’s “Final Solution”

Historians have acknowledged different elements that combined to produce the Holocaust, ranging from ideology and totalitarian leadership, to detached and numerous bureaucrats and desk-murderers, to rank-and-file executions as those common people who support their work. Between these polar ends – the upper echelon leaders who remained largely disconnected from the on-site murders and the slave laborers who assisted them – there is a middle level functionary who is in a different position. The high level leaders concerned themselves with long-range plans, statistical reports, and efforts to realize the vision of the Fuhrer. Those individuals remained distant from the killings that they indirectly authorized. Many of the lower-ranking individuals who would take part in the actual killing of people would claim they were under orders, or working under threat of death. The few individuals who were on-site and who had the ability to act with a relative amount of personal initiative are the subject of this study. The purpose of this paper is to examine a small group of SS leaders who were given the responsibility of running Hitler’s extermination camps. The individuals that were appointed to oversee these centers represent an important middle-level of management in the extermination system, and they will be analyzed against the backdrop of interdisciplinary scholarship in order to gauge what attributes these men possessed, the extent to which they affected camp operations, and whether they met the expectations of their superiors.

Mentor: Dr. Peter H Hoffenberg
Molecular Taxonomic Identification of Nematode Species in Hawai’i

Nematodes that attack and parasitize plants have become an issue for agricultural crops and food security in Hawaii as well as other localities around the world. Identifying nematodes using DNA could greatly facilitate identification of nematodes to the species level. This could be of vital importance for assessing biodiversity and for finding ways of properly dealing with these destructive and highly invasive species. In this study, the relatively new DNA based method known as “DNA Barcoding” is used. Barcoding uses DNA sequences obtained from one specific gene that has been characterized in a wide range of organisms. Using this approach we hope to identify the presence of destructive plant-parasitic nematodes such as root-knot nematodes in the genus Meloidogyne, possibly down to the species level. For this project the organisms used were both laboratory cultured nematodes and wild specimens collected in a field on Kauai near Kauai Community College (KCC). This process included 4 basic steps: (1) extracting DNA of specimens, (2) using PCR to amplify copies of the COI “barcode” gene as well rRNA genes to produce viable DNA sequences, (3) analysis of DNA sequences obtained using computer software programs such as DNAStar, (4) comparisons of DNA sequences to international databases such as GenBank. Through our analysis we have identified nematode species such as *M. arenaria*, *M. incognita*, and *M. javanica* to be present in our collections. Further research will be done to identify more species and find proper implications for treatment of the parasites.

Mentor: Dr. David Haymer
Evolution of Symbiotic Gut Biota and its Relationship to Fatty Acid Storage in Mexican Cavefish

Gut microbiota is crucial for gut development, gut homeostasis and proper function of host immune system, metabolism and neural processing. Short-chain fatty acids are an emerging component that microorganisms supply to the host which appears crucial for gut structure, immune response and neural processing. *Astyanax mexicanus* is a species composed of blind cave-dwelling morph and their sighted surface-dwelling morph. The sighted cave fish ancestors were trapped in caves millions of years ago, shifting their diet of small fish and crustaceans to a lean diet of rotten organic matter and bat guano. Despite significant changes, they remain interfertile, allowing us to apply powerful genetics to resolve the evolution of the gut biota symbiosm. Here, we performed genetic analyses on gut morphology, gut biota and fatty acid composition of cave fish, surface fish and F1 hybrids. They were fed three diets—nutrient-rich brine shrimp, nutrient-poor spirulina and bat guano. Morphometrics revealed that cavefish have significantly less pyloric caeca, longer microvilli and a wider hind-gut than surface fish. Analysis of gut biota using 16S ribosomal RNA sequencing showed that surface fish and cave fish gut biota significantly differ, while F1 hybrids are an intermediate of both morphs. Regardless of diet, gut biota remains stable suggesting host genetics are involved thus, *Astyanax mexicanus* may serve as an alternative model to highlight the molecular mechanisms of the gut symbiotic interaction. We will report how gut morphology changed under the combination of diet, morph and fatty acid composition in surface fish, cave fish and F1 hybrids.

Co-Authors: Kate Coyle, Reade Roberts, Joanne Yew
Mentor: Dr. Masato Yoshizawa
Function of Mouse ORC4 Fragments in Female Meiosis

During female mammalian meiosis, the oocyte extrudes half of its chromosomes twice to reduce DNA content to 1N. The extruded chromosomes within polar bodies have minimal cytoplasm and are incapable of fertilization. The mechanisms behind polar body extrusion (PBE) are still unclear. We previously demonstrated that in both meiotic divisions of murine oocytes, the DNA replication licensing protein, ORC4, forms a cage only around the set of chromosomes to be extruded in the polar body and not around the chromosomes remaining in the oocyte for future fertilization. This ORC4 cage possibly helps expel chromosomes unused by the final oocyte. The proposed project tested what parts of ORC4 are necessary for cage formation. We reasoned that the cage required polymerization of ORC4, either with itself or another protein(s). Using the predicted three-dimensional structure for ORC4, we synthesized three mRNA-ORC4-HIS fragments (120 bp). These fragments represented amino acids facing the protein exterior that might disrupt the ORC4 cage by competitive binding with polymerization sites. We injected the mRNA fragments individually into MII oocytes and observed oocyte development. Two mRNA fragments, near the N-terminus and near the mid-region of the protein, inhibited ORC4 cage formation and also prevented PBE. The third mRNA fragment, containing parts of the C-terminus, had no effect on ORC4 cage formation or PBE. These results suggest that ORC4 is required for cage formation and PBE, which is an essential process for prevention of clinical disorders related to chromosomal abnormalities such as Down and Turner Syndromes.

Mentor: Dr. W Steven Ward
Method Development: Isolating Microplastics from Copepods in the Ala Wai Canal

Microplastics are less than 5 mm in size (Zarfl & Matthies, 2010) and originate from the breakdown of larger plastics, cosmetic scrubbers, synthetic fibers, and air-blasting (Cole et al., 2011). Past studies have indicated a concern for bioaccumulation of microplastics in the food chain as a possibility (Cole et al., 2011; Desforges et al., 2015; Zarfl & Matthies, 2010), but no published data testing this hypothesis has appeared in the literature. Therefore, the focus of this project was on developing methodologies to identify whether or not microplastics exist in the Ala Wai Canal and if they are consequently available and consumed by the canal’scopepods. This study analyzed the efficiency of methods that involve copepod ingestion of microplastics less than 1mm in size. Results indicated that plankton tows were the most efficient method of collecting copepods and microplastics, that digestions were not very effective, and that a baseline understanding for the features and properties of microplastics less than 1 mm in size still requires testing in order to isolate microplastics from copepods in their natural environments. In conclusion, further baseline studies and knowledge needs to be acquired before one can determine whether or not microplastics are biologically available to zooplankton, much less determine if bioaccumulation up the food chain is a possibility.

Mentor: Dr. Karen Selph
Expression of Alternative Ribosomal Proteins in *Mycobacteria smegmatis* under Stress Conditions

The biological function of ribosomes to perform translation on encoded mRNAs is vital for life. Mycobacterium tuberculosis (Mtb), the causative agent of TB, has been shown to express both primary and alternative ribosomal proteins (AltRPs). A primary ribosomal protein S18-1 is more likely to be incorporated into ribosomes when zinc is available. At low zinc concentrations, however, the expression of homologous AltRP, S18-2 protein dramatically increases, and it is able to replace S18-1 during ribosome biogenesis. S18-1 and AltRP S18-2 proteins are also found in a related nonpathogenic bacterium Mycobacterium smegmatis (Msm) and therefore we used this organism to further investigate AltRPs. We tested if conditions other than low zinc induce AltRP expression. In vitro stress conditions were chosen to test for expression of AltRPs based on similar physiological stresses that Mtb encounter during infection. First, a series of Microplate Alamar Blue Assays were performed to determine minimal inhibitory concentrations (MICs) for Cumene hydroperoxide (oxidative stress), DETANONate (nitric oxide stress), Diamide (thiol oxidation stress), and Plumbagin (superoxide stress). Further, we exposed Msm to stresses at or below their MICs and followed expression of AltRPs by using a fluorescent reporter controlled by the altRP promoter. However, results from fluorescence readings show an increase in AltRP expression when Msm is exposed to Cumene hydroperoxide compared to the untreated Msm cells. Currently, we plan to purify and analyze ribosomes in cells exposed to the Cumene hydroperoxide in order to get a better understanding how their composition changes in response to stresses.

Mentor: Dr. Sladjana Prisic
MAHALO NUI LOA to Interim UH–Mānoa Chancellor David Lassner, Vice Chancellor for Research and Interim Vice Chancellor for Academic Affairs Michael Bruno, and Assistant Vice Chancellor for Undergraduate Education Ronald Cambra.

STUDENT VOLUNTEERS
We would like to thank the student volunteers who helped to set up and take down the facilities and to monitor the rooms during sessions.

STAFF
The organizers would like to extend a special thank you to their respective office staff for all their hard work behind the scenes during the conference and throughout the year. Thank you to:

Michelle Brown Graduate Assistant, Honors Program
Dr. Siobhān Ní Dhonacha Academic Advisor, Honors Program
Dr. Vernadette Gonzalez Director of Honors Program & UROP
Dr. Sue Haglund Educational Specialist, Honors Program
Angelique Lepordo Student Assistant, Honors Program
Troy Peiler Student Assistant, Honors Program
Dr. Jayme Scally Academic Advisor, Honors Program
Jasmine Samiere Student Assistant, UROP
Sheela Sharma Educational Specialist, UROP
Sylvia Wu Educational Specialist, Honors Program

SPECIAL THANKS
We would like to thank our event partners:
Ako Kifuji and Ahmad Ramadan for catering from Da Spot
Campus Center Meeting and Event Services Staff for facilities and planning assistance
Copy Hut Hawaii for program and poster printing services
Sakamaki Hall for use of facilities
Sodexo staff for catering services
ACKNOWLEDGMENTS

JUDGES AND MODERATORS
We would like to thank all the faculty members, administrators and researchers who volunteered to judge and moderate the sessions and to lend their experience and expertise to this student conference:

FACULTY JUDGES
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Dr. Philip von Doetinchem  
Dr. Lori Yancura

GRADUATE STUDENT MODERATORS AND JUDGES
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Becca Lensing  
Nicole Muszynski  
Jourdan Posner  
Roberto Rodriguez  
Nicole Schlaack  
Maura Stephens  
Lindsay Veazey  
Nathaniel Wehr
ACKNOWLEDGMENTS

FACULTY MENTORS
We would like to acknowledge the time, effort and expertise that faculty mentors put into advising students on their projects. Mahalo to the following people for their hard work:

Dr. Jeffrey Acido             Rick Mills
Andrew E Christie            Dr. Anupam Misra
Dr. Katalin Csizsar           Dr. Craig E Nelson
Dr. Jonathan Deenik           Dr. Ho Leung Ng
Dr. Kyle Edwards              Dr. Melissa R Price
Dr. Carolyn Faithfull         Dr. Sladjana Prisic
Dr. Victoria Fan              Dr. Andy Reilly
Dr. Noelani Goodyear-Kaʻōpua Dr. Karen Selph
Dr. David Haymer              Dr. Wei-Wen Su
Dr. Susana Helm               Dr. Florence Thomas
Dr. Peter H Hoffenberg        Michael B Thomas
Dr. Eric Hurwitz              Dr. Rob Toonen
Dr. Gaur Johnson              Monika Ward
Dr. Samir Khanal              Dr. W Steven Ward
Dr. Jason Leigh               Dr. Thomas Yee
Dr. Takashi Matsui            Dr. Masato Yoshizawa
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The Undergraduate Research Opportunities Program (UROP) was formed in 2011 with generous support from UH Mānoa Chancellor Virginia Hinshaw to promote and foster undergraduate research initiatives at UH Mānoa by offering funding for undergraduate research projects and providing access to on- and off-campus research opportunities.

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