

MONTANA STATE UNIVERSITY
WINTER 2023

YEAR CELEBRATION OF
**UNDERGRADUATE
RESEARCH**

Celebrating research and creativity
in all academic disciplines.

NOVEMBER 29 SUB Ballrooms
10 a.m. – Noon | 12:30 – 2:30 p.m.



MONTANA STATE UNIVERSITY STUDENT RESEARCH CELEBRATION WINTER 2023

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MAP & POSTER LOCATIONS

SUB BALLROOMS

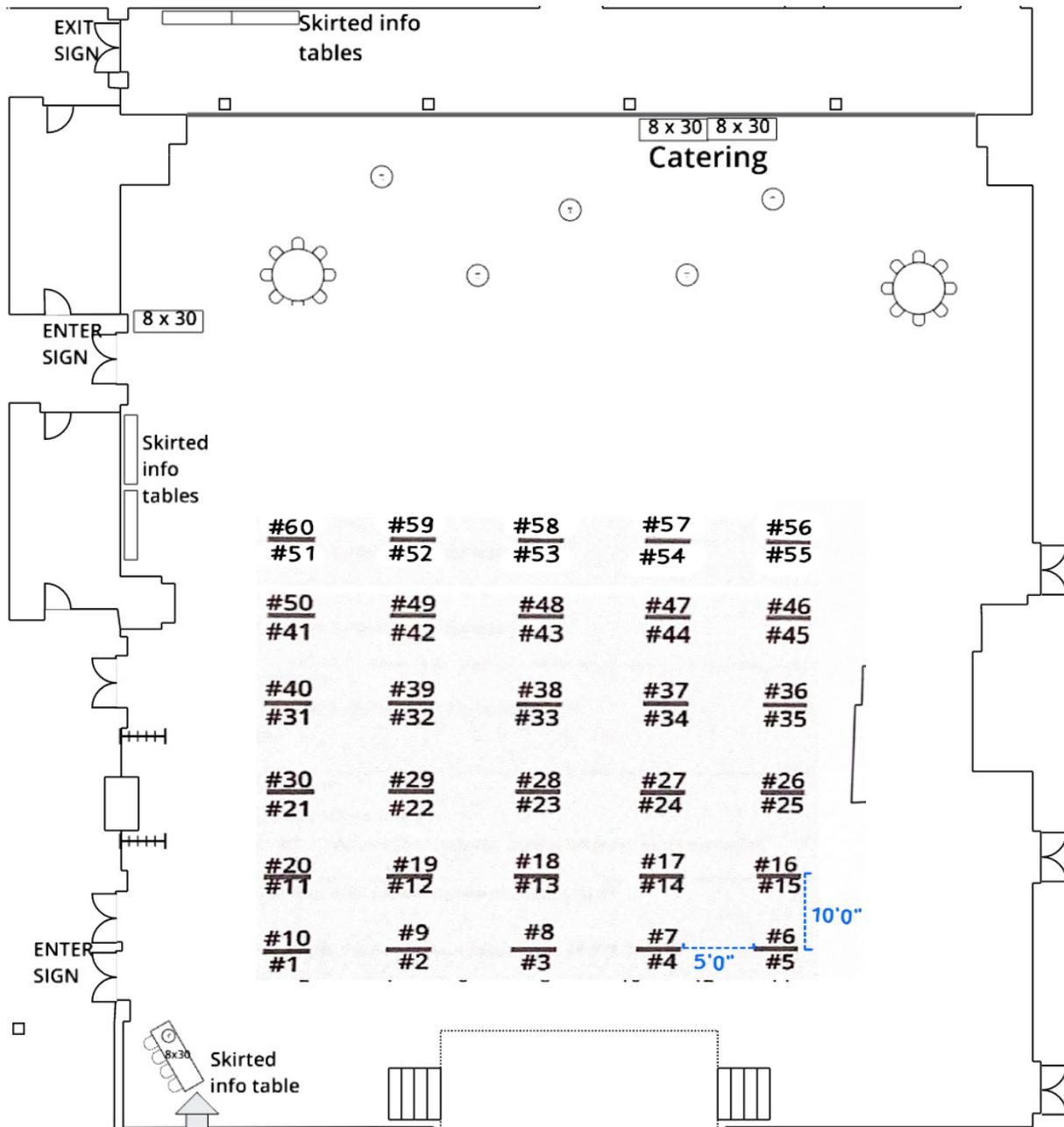


TABLE OF CONTENTS

Presenter Locations/Pages	i
Presentation Abstracts	1
Alphabetical List of Presenters	v

Presenter Locations & Page Numbers

Event Time: 10:30 AM - 1:30 PM

Break/Refreshments at noon

Location: SUB Ballroom

ARTS & MUSIC

POSTERS 1-22

PRIMARY AUTHOR/S	TITLE OF RESEARCH PRESENTATION	POSTER	PAGE
Ian Anderson	<i>Restoration of a 19th-Century Clarinet</i>	1	2
Storrs Bishop	<i>Wearing Survivance</i>	2	2
Ross Brown	<i>The Effect of Western Culture on Native American Art</i>	3	3
Questian Dovky	<i>Diné and Haida Weaving: Enduring Symbols</i>	4	3
Gracie Dusbabek	<i>Beyond Fashion: The REDress Project</i>	5	4
Alex Friedman	<i>Who New?</i>	6	4
Miles Heesepelink	<i>Environmentalism in Native American Art</i>	7	5
Toby Allan Kroening	<i>The Cultural Differences Within the Use of Beadwork</i>	8	5
Mandi McCarthy-Rogers	<i>Appropriation vs. Appreciation</i>	9	5
Courtney McGrath	<i>Native American Silversmithing Techniques</i>	10	6
Erica O'Borsky	<i>Buy Your Turquoise From Native Artists</i>	11	7
John Palmer	<i>Justin Jacob Louis</i>	12	7
Megan Peck	<i>Significance of Gender in Traditional and Modern Diné Fashion</i>	13	7
Jessica Reitan	<i>Indigenous Futurism in Fashion</i>	14	8
Annamarie Thomas	<i>Redesigning Native Fashion: Wendy Red Star</i>	15	8
Olivia Thomas	<i>Anthropological Effects on Native Cultures</i>	16	9
Jessica Tucker	<i>Rebecca Belmore: Life and Art</i>	17	9
Makena Walker	<i>Native American Southwestern Turquoise and Silversmithing</i>	18	10
Ella Weise	<i>Frankie Welch</i>	19	11
Charles Wern	<i>Polar Clothing Techniques and Production</i>	20	11
Austin Whisler	<i>The History of Music (Abridged)</i>	21	11
Yufu Yoshimura	<i>A Global Inventory of Double Reed Instruments: A Cultural Perspective</i>	22	12

ECOLOGY, EARTH & ENVIRONMENTAL SCIENCES

POSTERS 23-30

PRIMARY AUTHOR/S	TITLE OF RESEARCH PRESENTATION	POSTER	PAGE
Brendan Clark	<i>Digital Rendering of a Unique Turtle Specimen from the Blackleaf Formation, Montana</i>	23	14
Sarah Kincy	<i>Creating Hydraulic Vulnerability Curves for Two-Year-Old Limber Pine and Ponderosa Pine Seedlings</i>	24	14
Logan Light	<i>USING SANIDINE TRACE ELEMENTS TO DISCERN BETWEEN TWO RHYOLITIC UNITS IN YELLOWSTONE NATIONAL PARK</i>	25	15
Logan Light	<i>Deciphering the Thermal History of the Great Valley Forearc Basin at del Puerto Canyon, California</i>	26	15
Zoey Pasternak	<i>The Pith(y) Solution of Wheat Stem Sawfly in Durum Wheat</i>	27	16
Oskar Robinson	<i>Evaluating drought stress between high-elevation five needle pines: Pinus albicaulis and P. flexilis</i>	28	16
Benjamin Speirs	<i>Comparison of VOC Compositions of Two High Elevation Five Needle Pines</i>	29	17
Reilly Stack	<i>Does cover crop interseeding impact weed communities in organically grown carrots?</i>	30	17

EDUCATION & HEALTH

POSTERS 31- 41

PRIMARY AUTHOR/S	TITLE OF RESEARCH PRESENTATION	POSTER	PAGE
Mikynzi Aylesworth	<i>Physical activity and its effects on inflammatory markers in at risk adults.</i>	31	20
Coralee Bock	<i>Investigating the Positive Impacts of Fiber Content in Lentils on Satiety: a Randomized Controlled Trial</i>	32	20

Caleb Brownell	<i>Postprandial Lipoprotein Response between Beef and Lentil Meals</i>	33	21
Ayomide Foluso	<i>Influence of Kinship Caregiver and Family Characteristics on Kinship Care Experiences</i>	34	21
Nicole Holt	<i>An Investigation of Patient Experiences When Seeking Care for Müllerian Anomalies in Montana</i>	35	22
Macie Hopkins	<i>IMU Validation from 3D Motion Capture</i>	36	22
Brian Kibirige	<i>Continued Professional Development among Secondary Agricultural Education Teachers in Uganda, a case study</i>	37	23
Reese Meyer	<i>Anthropometric Predictors of Postprandial Glucose Response After a High Fat Meal</i>	38	23
Gianna Migliaccio	<i>Negative Association Between Phase Angle and Age, FMI</i>	39	24
Enkhchimeg Sharav	<i>The Impact of Revised Curriculum on English Language Teaching</i>	40	24
Sumaila Yakubu	<i>Mathematics Teachers' Conceptions of The Theory Of Multiple Intelligences In Ghana</i>	41	25

MATHEMATICS, ENGINEERING & TECHNOLOGY

POSTERS 42-48

PRIMARY AUTHOR/S	TITLE OF RESEARCH PRESENTATION	POSTER	PAGE
Taylor Carey	<i>Engineering Biodegradable Plastics Through Thermophilic Value Added Polyhydroxyalkanoates</i>	42	27
Joseph DiGrappa	<i>Fabrication of Flexible Transistors via Additive Manufacturing</i>	43	27
Aubrey Kimmel	<i>An Application of Constrained Linear Least Squares to Estimate Metabolomic Reaction Rates</i>	44	28
Benjamin Kindgren	<i>Organic Memristor</i>	45	28

Farshina Nazrul Shimim	<i>Spatiotemporal Forecasting of High-Resolution Evapotranspiration Data in Agricultural Fields Using Tensor Decomposition</i>	46	29
Benjamin Vogel	<i>Clustering Flow Cytometry Data With Gaussian Mixture Models</i>	47	29
Taylor Wehausen	<i>Designing a Towing Tank Facility for Wake Vortex Experiments</i>	48	30

MICROBIOLOGY & CELL BIOLOGY

POSTERS 49-51

PRIMARY AUTHOR/S	TITLE OF RESEARCH PRESENTATION	POSTER	PAGE
Zoe Seaford	<i>Generation of Thiols via Pyridoxal Phosphate-Dependent Pathways in Absence of Disulfide Reduction</i>	49	32
Eli Selong	<i>Alternative approach for antibiotic susceptibility determination in Mycoplasma biofilms</i>	50	32
Sobha Sonar	<i>Assessing the impact of Baytril treatment on Mesomycoplasma ovipneumoniae-infected sheep</i>	51	33

PHYSICS & SPACE SCIENCE

POSTERS 52-53

PRIMARY AUTHOR/S	TITLE OF RESEARCH PRESENTATION	POSTER	PAGE
Erica Chwalik	<i>Mapping the Edge of the Magellanic Stream</i>	53	35
Mahpara Tasnim	<i>A Search for HI Emission in Galaxies at $z < 0.06$ using the GBT L-Band Drift Scan Survey</i>	54	35

ARTS & MUSIC

POSTERS 1-22

01

Restoration of a 19th-Century Clarinet

Ian Anderson, Music

Mentor(s): Greg Young, Music

The School of Music at Montana State University owns a 19th century boxwood clarinet that is in a state of disrepair; my project involves researching the history of the clarinet, learning how to repair it, and getting it restored to playing condition. With today's technology, it is easy to look up and listen to a performance or demonstration on one of these instruments, but I believe it would be more beneficial to have hands-on experience with such an instrument. I decided that I would look into the instrument further to gain a greater understanding of it, and once I had a general knowledge of the instrument and a better understanding of what needed repair, I would begin looking for someone capable of fixing it in keeping with historic preservation practices. Building on former student Karen Johnson's project gave me a general idea of its historical context. My oboe studio professor suggested I call the American Musical Instrument Society; I contacted them to see if they would be able to help me with my project. I also consulted local instrument repair specialist Ken Decker about his ability, expertise and interest in restoring the clarinet. My hopes are that he will be capable of repairing it back to playing condition, and it will be able to be demonstrated in period ensembles by faculty and students for years to come. I also plan to submit my research project for an undergraduate research journal.

Acknowledgments: USP - Undergraduate Scholars Program

02

Wearing Survivance

Storrs Bishop, Art

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

Modern Native fashion designers and artists are manifesting Gerald Viznor's concept of survivance through their adaptation of Western styles, techniques, and business models to reflect their traditional values and indigenous identity. This paper explores three artists' use of fashion and clothing to maintain and perpetuate their cultural identities through the vitalization of their traditional art forms in the shape of contemporary commodified objects. Terri Greeves (Kiowa) associates a Native artist beading in the modern world as an act of resistance. John Paul Judd (Kiowa and Choctaw) and Wendy Red Star (Apsáalooke) use the visual languages of graphic design and conceptual sculpture to critique modern American culture and consumer values. Greeves is carrying the physicality of the traditional culture into the present and the future with her beading; Judd and Red Star are carrying traditional values forward to create spaces within the larger American culture for Native identities. Each of these artists uses their lived experiences in the American monoculture to inform versions of Native cultural adaptation through what we wear on our bodies.

03

The Effect of Western Culture on Native American Art

Ross Brown, Art

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

The Native American people lived and prospered in this country for thousands of years before Westerners made their settlements. The indigenous peoples had created a very well implemented culture in their given tribal territories. Tribes flourished, expanded, and they moved around, mastering a harmonious relationship with the landscape. Their environment provided an experience unique to each climate, ultimately influencing their crafts and progression of their primitive technology. Western Europeans landed on the East coast of modern-day America and immediately had a lasting effect on the surrounding natives. I will be researching and providing an in-depth look at how the expansion of western culture in America affected the natives that were already there. Specifically, how this new culture affected their emotions, and ultimately their art and clothing. I will show how western culture had an astounding effect on Native Americans culture, emotions, artwork, and clothing by comparing the lives of the indigenous people before, after, and during the expansion of western culture upon the natives' land. I will research the significance of the landscape on the art of the natives and how that landscape was changed by the westerners, and ultimately changed their art and clothing. All this will be done in order to have a better understanding of what the natives went through and how the actions of westerners affected their art and their livelihood.

04

Diné and Haida Weaving: Enduring Symbols

Quest Dovky, Art

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

Comparing the weaving cultures of the Haida and the Diné , this research aims to investigate the transformation of their weaving traditions and symbols in response to colonial influence by exploring the role of modern artists in revitalizing and transforming these weaving traditions and symbols, shedding light on the ways in which contemporary practices reinterpret the traditional. Utilizing formal comparison of artwork of Diné woven rugs and blankets and Haida woven and painted spruce-root hats from the established histories and literature on the respective cultures, and comparing the practice and process of contemporary artists Venancio Aragon (Diné) and Isabel Rorick (Haida) with the known histories, I aim to highlight the resistance of past and current colonial forces that impact both First Nation communities through the art and craft of weaving. As a result, this research will undermine the idea of "tradition" of First Nation's people as a by-gone past, and more so now the current goal and philosophy of "Survivance", a term that aims to decolonize the idea that indigenous people are a "dying people" that are victims of the past, when in fact their survival is resistance. In the case of this research, art as a process is one of the many tangible means of resistance against colonial forces for both the Diné and Haida nations.

05

Beyond Fashion: The REDress Project

Gracie M. Dusbabek, Art

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

The REDress project was founded by Jaime Black in 2010 to bring attention to the thousands of missing and murdered indigenous women and girls in North America over the past four decades. Outdoor installations of empty red dresses draw attention to the issue as well as honoring the victims. The dresses are collected through donations from the public and families. The color red has been chosen for these installations because it is considered the only color spirits see while symbolizing both vitality and violence. The installation has been exhibited in more than 31 locations in Canada. The impact of the installation has been so powerful that it brought inspiration to Red Dress Day in Canada on May 5th, a day to bring awareness for missing and murdered Indigenous Women and Girls. After bringing such an awareness to the community, the Canadian government launched the National Inquiry into Missing and Murdered Indigenous women and Girls in 2016. After all of this national and international recognition of the REDress project, this makes me question how fashion can provoke change, and how powerful is fashion. For this project, I will reflect on the impact the REDress project has made both nationally and internationally as well as how native artists have drawn inspiration from the installation in their own style. This project will also examine the social and political impacts of fashion.

Acknowledgments: USP - Undergraduate Scholars Program

06

Who New?

Alex M. Friedman, Art

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

Lloyd Kiva New became a pioneer in designing native fashion, this paper will examine how New revolutionized fashion and the approaches and methods he used in doing so. New's work in fashion was groundbreaking, he seamlessly blended traditional Native American motifs with modern designs. His innovative approach not only reinvigorated Native fashion but it challenged stereotypes and showcased the sophistication of indigenous craftsmanship. This paper will also compare similar artists to New based on methods of reinvigoration. Also being explored within the paper will be an analysis of the specific prints and fabrics New used. This will show how materials and designs can affect the outcome of a garment. Ultimately showing how they were perceived by the public.

Acknowledgments: USP - Undergraduate Scholars Program

07

Environmentalism in Native American Art

Miles Pierson Heespelink, Art

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

I want to research how contemporary native art and fashion speaks to environmental issues. I really care about the environment myself and love to have a great time outdoors. During this project I hope to research native artists who make work about the climate or about the climate of the native population. I'm not sure what my paper is going to look like just yet but I want it to speak to the fact that we slaughtered and killed much of the food and land that native people needed to survive. We ruined their traditional way of life and in writing this paper I hope to uncover why and how we did this. I was always really stricken by the fact that we killed all the damn near all the buffalo and I want to talk about that for a lot of my paper. I don't know of any artists that make work that directly speak to some of the problems but I know I will be able to find some. For my poster I want to include facts and statistic that show how colonization has affected the native people land. I also want to include paragraphs of text that talk about how the Native art we see speaks to this issue.

Acknowledgments: USP - Undergraduate Scholars Program

08

The Cultural Differences Within the Use of Beadwork

Toby Allen Kroening, Art

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

In this presentation the information presented will be on how the Navajo Native Americans and the Aztec cultures used beads to represent their respective cultures and sense of self. Do cultures located in similar geographic locations use beads differently or do they use them in the same way? Why do they choose beads as a way of self-representation? Are each cultures use of beads different historical compared to modern day? Have they grown similar in their uses, or does it vary? These are the questions that I am seeking to answer to understand better different cultures, different styles and the history behind these ideals.

09

Appropriation vs. Appreciation

Madison Jackson, Art

Mentor(s): Mandi Ann McCarthy-Rogers, Art

I wanted to spend some time doing extensive research on Christie Belcourt! She is a Metis artist who loves painting her designs in dots and magnificent colors. What caught my attention with her is her artistic context and style. Everything she puts on a canvas symbolizes her Metis culture along with deeper meaning. I want to really examine her creative process, her story, how she comes up with each creative idea, who she is involved with expressing her art, where her art can

be seen, and any obstacles she has ran into. There is 1 painting I want to incorporate within my poster. They are magnificent, and I feel they really show her differentiation of style compared to other artists. I think it is important to incorporate her different mediums so viewers can see how her designs look on canvas versus on clothing. I want to show her prints that have been transferred over into purses, clothing, and any other material. She has plenty of social media platforms that I can visit with no problem, and I think this is important to understand Belcourt as much as possible, so I answer questions from viewers. She is truly a talented artist when it comes to her work, and I want to show others here at Montana State more information about her. For my poster, that will be viewed to the public, I want to really capture her design. I want individuals to see the vibrance of my poster that best represents the artist I am putting on display. I want individuals to be involved and to be visually pleased because Christie's work memorizes me. I am going to be very selective when it comes to her paintings because I want to emphasis her talent along with her clothing designs. She had done an interview and a Q & A with her audience about "appropriation vs. appreciation". She goes into depth that she has seen this at various of fashion shows including higher up brands. She is very involved and respectful of her designs making sure that she isn't appropriating any of her designs. She does research if any questions arise or directly asks her mentor who is also Metis. I want viewers to see this. I want to incorporate this within my poster and if I don't have enough room then I will make sure and educate viewers on the spot.

Acknowledgments: USP - Undergraduate Scholars Program

10

Native American Silversmithing Techniques

Courtney L. McGrath, Art

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

Silversmithing is a somewhat new trade among Southwest Native Americans. It was taught to them by the Spanish and Mexicans in the 19th century. It was the Navajo who first learnt the trade, with the Pueblo, Hopi, Santo Domingo, and Zuni learning after them. It was the Pueblo who integrated the use of turquoise and shells, with them starting to be set in jewelry with the turn of the century. The making of jewelry set off when traders encouraged the selling of Native jewelry to tourists. Each tribe had something it was known for - the Santo Domingo and Zuni peoples produced a lot of turquoise bead earrings and necklaces and the Navajo made more with silver and turquoise, with a common item being heavy silver and turquoise bracelets. There are several different metalsmithing techniques that are common among Native jewelry. Tufa casting was a method developed by the Navajo, which involves carving a design in tufa, a soft volcanic rock, and pouring molten silver into it. Sand casting is also common, which involves pressing something into sand and then pouring molten silver into the impression left. Overlay is a technique used by the Hopi people, which involves laying sheets of silver with designs cut out. Inlay is a technique used most commonly by the Zuni jewelers, where multiple stones are inlaid in a pattern or design.

11

Buy Your Turquoise From Native Artists

Erica A. Oborsky, Art

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

Turquoise holds different meanings and representations amongst Native Americans, but for some tribes it historically was a spiritual symbol. This research dives deeper into the history of turquoise in America, and how traditional Native American jewelry designs have been appropriated. Featured artist, Elise Lopez, is a Ramúri and Yaqui metalsmith located in Colorado. Elise is self taught, and began making art full time in 2021. They started a business called Wild Lobo where they sell a variety of jewelry products, many incorporating turquoise. Elise Lopez is an inspired Native artist who encourages people to support authentic artists and not jewelry inspired by stolen Native designs.

Acknowledgments: Course - ARTZ491 - Native American Clothing

12

Justin Jacob Louis

John Dominic Palmer, Art

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

I will be conducting my research presentation on artist and designer from the Samson Cree Nation, Justin Jacob Louis. Justin is the designer and founder of the Native streetwear brand SECTION 35, as well as luxury brand Justin Jacob Louis often shortened to JLL. My presentation will start with the founding and starting of his brands, as well as the style and influence he carries within his creative practice. I will dive deeper into his thought process and goals as a Native designer, and take a look at the challenges he faces in the fashion world as a Native designer. I will also highlight recent achievements in both brand, such as shows, promotional material, and magazine features. Finally, I will cover future design plans he has for himself and his brands.

Acknowledgments: Federal funding through your research mentor (NSF, NIH, NASA, DOE

13

Significance of Gender in Traditional and Modern Diné Fashion

Megan Peck, Art

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

This research explores the concept of gender and Hózhó in twenty-first-century Diné fashion through the work of Orlando Dugi and Jolonzo Goldtooth. The work of both artists pushes modern fashion with more influence from his Diné ancestors than originally meets the eye. The concept of more than two genders is a modern concept to many US citizens today, however, in traditional Diné culture there are five perceived genders. Orlando Dugi pushes the limits of gender identity within fashion, which not only encourages modern fashion to blur gender norms

but also displays his culture's traditional gender beliefs. Each of his pieces is sourced and made following traditional Diné craft, and sway strongly against current fast fashion trends, being hand-made, and using traditional styles for beading and embellishments. Intertwining his personal memories and values within his culture with modern, trend-setting fashion makes his work both unique and impressive. Hózhó is a concept unique to the Diné people, meaning balance and beauty, which I think is a perfect description of his work, which balances the beauty of traditional and modern design by using traditional Diné clothing techniques to transform modern design into a meaningful self-reflection of mainstream clothing gender classifications.

14

Indigenous Futurism in Fashion

Jessica A. Reitan, Art

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

Indigenous futurism is an art movement inspired by science fiction that speculates about an Indigenous based future and the way that Indigenous culture can evolve in tandem with technology. The term "Indigenous futurism" is inspired by "Afrofuturism" which follows themes of liberated futures and activism. Indigenous futurism incorporates alternate realities, new worlds, and even revolution. Many Native artists utilize this movement to evoke critical thinking regarding both past and present colonization and its overall impact on Indigenous culture. It also often speculates on a present in which European settlers had not come and impacted Native culture at all. The Indigenous futurism art movement has been incorporated into fashion by various designers and paired with creative photography in order to educate people and raise awareness on these concepts. By delving into Indigenous futurist shows such as Wendy Red Star's *Thunder from Above*, Vergil Ortiz's *Revolt 1680/2180: Runners + Gliders*, and Cannupa Hanska Luger's *Future Ancestral Technology*, one can begin to develop a wider breadth of understanding of the movement as a whole and its commentary on colonization.

15

Redesigning Native Fashion: Wendy Red Star

Annamarie Thomas, Art

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

Clothing has always played an essential and important role in the lives and cultures of Indigenous peoples. Clothing is often representative of tribal affiliation, ancestry, and one's role within the tribe. Modern Native fashion designers and artists today work to keep these important connotations that surround clothing while simultaneously driving it into the modern age. Native artists are able to spark conversation about contemporary Native life through fashion design as well as by utilizing traditional clothing in their artworks. Wendy Red Star is a prominent Native artist whose work often confronts the romanticization that surrounds Indigenous peoples, both in the past and present. This research analyzes Red Star's artworks, specifically focusing on clothing as a staple of her pieces. It will take into consideration Red Star's upbringing as a member of the Apsáalooke tribe, the evolution of her art throughout her life, and her continued focus on exploring the intersections of Native and colonial culture. It will also examine Red Star's

impact on the broader non-Native world and the ways in which her pieces work to deconstruct the false narratives that surround Indigenous people.

Acknowledgments: Other funding

16

Anthropological Effects on Native Cultures

Olivia Michael Tromans, Art

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

An interest in the anthropology and study of Native customs, practices, and cultures in the United States has recently grown over the 20th and 21st Centuries. With programs such as 'Native American Studies' on campuses across the United States and museum exhibits centering on Native practices becoming more common, an emphasis on the importance of understanding and learning about Native cultures has emerged. However, it is important to acknowledge the damage that anthropological research has done to Native cultures in the past, as well as how it continues to impact them today. The interest in anthropological research centered around Native cultures during the late 20th and early 21st Century was sparked largely because of the thought that Natives were slowly dying out and essentially going extinct, giving rise to the "Myth of the Dying Indian." While anthropologists at the time were interested in Native cultures, it was because they wanted to preserve what they could before the Natives "disappeared" rather than a desire to prevent these cultures from dying out. This caused practices such as the museum collecting of Native items of cultural significance to become widespread. The extent of museum collecting even went as far as collecting organic material from Native peoples. One such instance, the case of Ishi, dubbed "the Last Wild Indian", led to his brain being preserved and collected by the Smithsonian National Museum of Natural History. While Ishi was alive, he requested not to have his body autopsied, yet his wishes were gone against in the name of anthropological research. While his remains were eventually recovered and his brain was buried with his ashes, this still shows that anthropology, while important, has a long way to go when it comes to proper handling and care of items that belong to Native cultures.

Acknowledgments: USP

17

Rebecca Belmore: Life and Art

Jessica Tuggey, Art

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

Rebecca Belmore is a Canadian activist who uses art to represent the emotions of Indigenous tribes across the North American Continent. Raised with the traditions of the Ojibwe tribe, Belmore has devoted her career to the advocacy of her people with the usage of multimedia art including film, clothing, photography, and painting. Belmore started her career in the late 80s, while still in college in Ontario Canada. While studying she intentionally put herself into a cage with signs that were similar to ones found in a museum. This was done with the intent to draw attention to how Canadian museums inappropriately display Native artifacts, rather than return

the artifacts to the tribes. These displays in her college career propelled her advocacy into her adult career to an international platform. Looking through her website, there was a clear theme of indigenous people's rights, and the issues they face. Later in her career Belmore created a short film about the injustice of Indigenous women going missing since the 80s. Belmore opens the film with her in a homemade red dress, as the film continues, she destroys the dress while letting her emotions take control of her and her actions. Throughout her career she has used her platform to raise awareness about indigenous issues through her use of the self-made costumes, her sculptures, and her use of film. Throughout this project there are multiple examples of how she advocates for her people, and her culture.

18

Native American Southwestern Turquoise and Silversmithing

Makena Walker, Art

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

Since the 19th century, Southwestern Native American tribes have artfully melded Mexican silversmith techniques with the culturally rich gemstone, Turquoise. For these tribes, Turquoise is more than just a mere mineral as it stands as an enduring thread, weaving together generations, evolving into a cornerstone of their economy and a sacred embodiment of Native Southwestern heritage. As early as the sixth century the ancient Puebloan, who once inhabited parts of New Mexico, mined the mineral, extracting turquoise with rudimentary tools and then carving it into beads, pendants, and nose plugs. Today, much of the mineral has been mined out. Turquoise is celebrated largely in part of its diversity. The gem is formed as water meanders through a host rock enriched with copper, aluminum, and other minerals, which combine to create deposits over time. Depending on the mineral composition, the spectrum of turquoise can range from a bright sky blue to deep green, encompassing countless iterations in between. The land of New Mexico is now home to twenty-three Indigenous tribes, most notably, the Zuni, Navajo, and Hopi tribes, each intrinsically connected to Turquoise and the art of silversmithing. These tribes have developed distinctive techniques and intricate stonework designs that each echo the tribe's cultural identities and traditions. There is the cluster work of the Zuni; the two-tone silver overlay of the Hopi; and the elaborate silversmithing of the Navajo, with stone adorning bracelets, concho belts, and bolos. As we stand at the threshold of the 21st century, significant challenges emerge. Cultural appropriation, misrepresentation, and the proliferation of counterfeit pieces threaten the authenticity and sanctity of this art form. These challenges underscore the need for greater respect and understanding of the traditions, history, and cultural significance intertwined with this art. Shedding light on enduring the legacy of Native Southwestern Turquoise silversmithing serves as a bridge between the past and present while offering insights into the interplay between tradition, innovation, and cultural preservation in the modern era.

19

Frankie Welch

Ella R. Weise, Art

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

Frankie Welch (1924-2021) was an American designer and entrepreneur best known for producing thousands of custom scarves. Welch's pieces used silkscreen printing to achieve her patterns. She introduced her first scarf design, the Cherokee Alphabet, in 1967, quickly followed by her Discover America scarf for the White House and prominent political designs for the 1968 presidential election. She focused on designing for 1970s and 80s politicians, famously being the creator of the dress Betty Ford wore to her husband's inauguration in 1975. In 1976 she made a tea towel design for the bicentennial council of the thirteen original states. She made a custom scarf for woman of the year Rosalyn carter of woman's national democratic club in 1977. That same year she also made a scarf design for jimmy carter. In 1980 she made a design for William & Mary college. In 1981 She made a design for auto-train. In 1983 she made a handkerchief design for the national cathedral Washington DC.

20

Polar Clothing Techniques and Production

Charles Wern, Art

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

This poster will explore traditional clothing production in Native and First Nation cultures of the Arctic and Subarctic with emphasis on the connections between material usage and the environment. While technical aspects of clothing such as material procurement and sewing techniques will be covered, this project will also explore how embellishments and ornamentation act as a form of cultural and personal expression. Further, this piece will also cover the creation of clothing in relation to the environment; specifically through the ideas of biomimicry. As issues such as climate change negatively affect Arctic and Subarctic communities today, this paper will conclude with how clothing persists as a valuable traditional art form and a means to share generational knowledge. Finally, this research poster hopes to inspire the reader to make connections between the importance of clothing production that maintains a healthy relationship with the environment.

21

The History of Music (Abridged)

Austin C. Whisler, Music

Mentor(s): Greg Young

Within the scope of Eurocentric Music History we learn in class – from textbooks, theory articles, and ensemble repertoire – the styles are often grouped into broad categories with perhaps overly generalized definitions. While there have been significant developments which happen between epochs of music history, one concept which is often underrepresented with these

definitions is how each tradition developed or sprung from its predecessors. Through the composition of a “Theme and Variations” style musical work I will map the structural development from Plainchant – or as early as I can reasonably achieve – through the many eras of the Western canon before dissolving through relevant contemporary styles and vanishing into the unknown of what styles have yet to develop. Based on the work of K Marie Stolba in her text *The Development of Western Music*, as well as supplemental journals along the way, I will compose in as many of these styles as possible while maintaining a recognizable melodic base. The final product will be performed in chronological order to best outline the transition between styles. This composition will provide a lens through which the audience may better understand the structural relationships across European music history. A successful composition is intended to be enjoyable in its own right for a modern audience. A presentation of the final work will be included at the campus undergraduate research celebration as well as a live performance at my senior recital in March 2024.

22

A Global Inventory of Double Reed Instruments: A Cultural Perspective

Yufu YOSHIMURA, Music

Mentor(s): Greg Young

Most people who have experience with the global phenomenon of western classical music are aware of the double reed instruments mainly used within that style. The most common in this genre are the oboe and the bassoon. Some may also be familiar with other members of these two instrumental families such as the English horn, oboe d’amore, and contrabassoon. However, few people are familiar with double reed instruments from other traditions. As an oboe player, I am particularly interested in how different double reed instruments, and particularly the timbre of the double reed, are used within the context of the culture from which they developed. Cultural aspects include traditional rituals, their role in folk music, the other instruments they are combined with, as well as historical and contemporary performance practices. I will find various papers and experts on a variety of different double reed instruments in order to gain a better understanding of the history of these instruments and to compare and contrast them. A partial list of instruments my project will cover include crumhorn, duduk, piffero, souna, guan, hichiriki, piri, and shehnai. I will create a website that can serve as a database of different double reed instruments in the world with a general overview and history. In addition, I will have a poster and/or a paper in order to make this information presentable in various forms. Dissemination will include our campus undergraduate research celebration and student-led journal.

ECOLOGY, EARTH & ENVIRONMENTAL SCIENCES

POSTERS 23-30

23

Digital Rendering of a Unique Turtle Specimen from the Blackleaf Formation, Montana

Brendan A Clark, Earth Sciences

Mentor(s): David Varricchio, Earth Sciences

In 2021, a small turtle specimen was recovered from the BL-1 locality of the Vaughn Member of the Blackleaf Formation of Montana. Previously, this site produced microvertebrate fossils representing multiple turtle taxa. However, this turtle specimen appears to be unique compared to these other specimens in both completeness and appearance. Along with centimeter-scale blocks of matrix containing small exposures of several elements, a larger piece was discovered including a carapace, plastron, and elements preserved in between that were not easily viewable at the time. With likely diagnostic bones hidden within the shell of the turtle, this specimen's unusual preservation and small size make manual preparation methods problematic for extracting this new data. Therefore, the use of a micro-CT scanner to analyze the specimen was necessary to visualize all of the preserved elements. Scan data has revealed numerous elements rarely discovered with other mid-Cretaceous turtles from North America. Digital renderings of elements include marginals, a cervical vertebra, a proximal humerus, an ungual, and a mandibular element. The amount of data in these scans alone offers promising insight into the morphology and evolutionary affinities of this small turtle specimen from the Blackleaf Formation of southwest Montana. This specimen should provide crucial information on the vertebrate diversity of the poorly known Blackleaf Formation and may further contextualize the evolution and diversity of turtles during the mid-Cretaceous

Acknowledgments: USP - Undergraduate Scholars Program

24

Creating Hydraulic Vulnerability Curves for Two-Year-Old Limber Pine and Ponderosa Pine Seedlings

Sarah Kincy, Ecology

Co-Authors(s): Sean Hoy-Skubik, Ecology

Mentor(s): Danielle Ulrich, Ecology

Anthropogenic driven climate change and subsequent drought conditions have negatively affected limber pine (*Pinus flexilis*) and ponderosa pine (*Pinus ponderosa*) populations through mass mortality events, jeopardizing the future of these species and the overall health of montane and subalpine ecosystems. The loss of xylem conductivity through embolism results in hydraulic failure, which is pervasive in tree mortality caused by drought. Complete hydraulic failure is likely not necessary for tree mortality; therefore, quantifying percent loss of conductivity (PLC) of xylem associated with tree death is important for understanding and predicting patterns of tree mortality. Hydraulic vulnerability curves can be utilized to quantify the percent loss of conductivity in the xylem at a given water potential, which can then be used to predict the lethal threshold for the species. To accomplish this, we created three hydraulic vulnerability curves, one from leaf xylem conductivity (Kleaf) of ponderosa pine, and two from stem xylem conductivity (Kstem) of ponderosa and limber pine. These were created by measuring the water potential and PLC of 30 two-year old seedlings having undergone different levels of water stress, ranging from no stress to severe water stress. The lethal threshold for hydraulic failure on the curves were determined using logistic regression. These curves can be utilized to better understand mortality of limber pine and ponderosa pine due to ongoing water stress, and ultimately help to conserve and protect these species from future drought conditions.

Acknowledgments: USP - Undergraduate Scholars Program

25

USING SANIDINE TRACE ELEMENTS TO DISCERN BETWEEN TWO RHYOLITIC UNITS IN YELLOWSTONE NATIONAL PARK

Logan Light, Earth Sciences

Co-Authors(s): Stacy Hendersob, Earth Sciences

Mentor(s): Madison Myers, Earth Sciences

Samples collected in Yellowstone National Park (YNP) in 2023 for research into the youngest supereruption, the Lava Creek Tuff (LCT, 0.63 Ma), indicate some possible discrepancies in the current geologic map. These samples appear visually distinct from known LCT units and may belong to older rhyolite flows, the most proximally mapped being the Island Park Mount Jackson series (IPMJ, 1.3-0.7 Ma). One of the best methods for differentiating igneous units within the park is through geochronology ($^{40}\text{Ar}/^{39}\text{Ar}$ dating). However, $^{40}\text{Ar}/^{39}\text{Ar}$ geochronology is time-consuming (6-8 months) and expensive, requiring another, quicker method that can be used to discriminate between eruptive units. One potential solution for distinguishing igneous rocks is obtaining concentrations of trace elements found within minerals such as sanidine. Trace elements can sometimes be used to fingerprint magmatic sources of erupted material, including the state of differentiation, and thus may serve as another method to differentiate LCT and IPMJ rhyolites. Sanidine separates picked from crushed and sieved whole rock were analyzed at Montana State University using laser ablation inductively coupled mass spectrometry (LA-ICPMS) for trace element concentrations (e.g., Sr, Ba) to test if this method can be used to differentiate between LCT and IPMJ rhyolites. These results will be assessed in conjunction with $^{40}\text{Ar}/^{39}\text{Ar}$ age results. Implications for this method of analysis would mean reduced time and cost for geologic resolution within the scope of the LCT and IPMJ rhyolites, and possibly the rest of the greater Yellowstone tuffs and lava flows.

26

Deciphering the Thermal History of the Great Valley Forearc Basin at Del Puerto Canyon, California

Logan Patrick Light, Earth Sciences

Co-Authors(s): Natalee Weis Earth Sciences

Mentor(s): Devon Orme, Earth Sciences

This study seeks to reconstruct the thermal evolution of the Great Valley Forearc (GVF) basin, California exposed in outcrop along its western margin. Despite the basin's abundant petroleum systems within the Central Valley, the thermal history of the western outcrop belt remains less understood. The GVF is saturated with syn- and post-depositional normal and thrust faults, as well as slip-strike displacement from the San Andreas fault system following cessation of deposition. We combine field mapping with geochronology and low-temperature thermochronology to reconstruct the thermal history of the GVF basin adjacent to major, previously mapped faults. At Del Puerto Canyon, the Tesla-Ortogonalita Fault (TOF), a thrust fault with right-lateral slip, has been previously interpreted as active from the Miocene to the present and may be responsible for exhuming parts of the GVF basin. Analysis of zircons using U-Pb geochronology sampled from Del Puerto Canyon within the GVF demonstrates that the Jurassic-Cretaceous Knoxville Formation was present during the slip along the TOF, constraining fault activity back to the Cretaceous at this location. Apatite and zircons (U-Th)/He results show thermal resetting of apatites, yielding dates of 55-10 Ma, while zircons show minimal resetting, with dates ranging from 106-63

Ma, coinciding with depositional ages. Ongoing thermal-history modeling seeks to constrain maximum burial temperatures and initiation of cooling. At present, the TOF has sections of near-vertical movement exhuming parts of the basin. Continued efforts seek to understand the structural complexity of the basin to further interpret and understand the thermal history of the basin.

*Acknowledgments: USP - Undergraduate Scholars Program
Federal funding through research mentor*

27

The Pith(y) Solution of Wheat Stem Sawfly in Durum Wheat

Zoey Pasternak, Ecology

**Co-Authors(s): Nancy Blake & Jared Lile, Plant Sciences & Plant Pathology,
Mentor(s): Jason Cook & Mei Ling Wong, Plant Sciences & Plant Pathology**

The wheat stem sawfly, *Cephus cinctus* Norton, threatens wheat production in the Great Plains of North America, leading to economic losses for agricultural producers. This research focuses on developing resistant hexaploid and durum wheat cultivars as a promising strategy for sawfly mitigation. Durum wheat (*Triticum turgidum* L.) lines were selected for an association panel to explore the relationship between stem solidness and wheat stem sawfly control. The study builds upon previous research identifying key quantitative trait loci (QTL) associated with sawfly resistance in hexaploid and durum wheat. The genetic distinctions were examined between hexaploid and tetraploid wheat species, focusing on improving stem solidness in hexaploid varieties by incorporating resistant alleles from tetraploid durum wheat. The Durum Association panel aimed to analyze the stem solidness phenotype of durum wheat, followed by statistical association mapping using best linear unbiased predictors (BLUPs) to identify associations between the traits and genes controlling the trait. This research will aim to uncover novel resistant genes that contribute to the genetic diversity of durum wheat. By bridging the gap between genetic analysis and practical agricultural solutions, the study outcomes will assist breeders in developing improved wheat varieties for farmers with enhanced resistance to wheat stem sawflies. *Acknowledgments: USP - Undergraduate Scholars Program*

28

Evaluating drought stress between high-elevation five needle pines: *Pinus albicaulis* and *P. flexilis*

Oskar Robinson, Ecology

**Co-Authors(s): Zoe Teal (Castleton University), Sarah Loosen (Universitat Tubingen)
Mentor(s): Danielle Ulrich & Lou Duloisy, Ecology**

The frequency, intensity, and duration of severe droughts and heat waves caused by climate change are projected to increase, affecting tree growth and survival (Allen et al. 2010, 2015). It is predicted that climate change will affect whitebark pine (*P. albicaulis*: WBP) and limber pine (*P. flexilis*: LP) (Hansen et al. 2021), although the physiological mechanisms underlying their responses to climate change are not fully understood. At two previously established sites, Teton Pass (TP) and Mile Creek (MC), we used a PMS pressure chamber to measure pre-dawn and midday leaf water potentials of (14) WBP and (14) LP during the 2023 growing season (June-September) (Alongi et al. 2019, Hansen et al. 2021). Leaf water potential is the measure of the amount of water available in the leaves of a plant and serves as a proxy for drought stress. Results/Conclusions:

Our initial results show no significant difference in water potential between WBP and LP in the months of June (TP: P-value, 0.26 MC: 0.97), July (TP: 0.94, MC: 0.32), and August (TP: 0.16 MC: 0.24). However, we predict during the warmer and drier month of September the means for WBP will become more negative while LP means will remain the same, meaning that WBP will be more drought stressed than LP. Given the critical role these species occupy, and the multi-faceted threats they are facing, it is critical to consider the physiology underlying WBP and LP drought stress to better predict how climate change will impact these species.

29

Comparison of VOC Compositions of Two High Elevation Five Needle Pines

Benjamin Yeakel, Ecology

Co-Authors(s): Katherine Sparks, Ecology

Mentor(s): Danielle Ulrich, Ecology

Volatile organic compounds (VOCs) play a ubiquitously important role in resistance to biotic and abiotic stressors across a diverse set of plant taxa. In high elevation five-needle pines, current research suggests that VOCs may mediate mountain pine beetle (*Dendroctonus ponderosae*) host preference and resistance. This project is focused on identifying differences in compositions and concentrations of VOCs between two high-elevation five needle pine species, whitebark pine (*Pinus albicaulis*) and foxtail pine (*Pinus balfouriana*). Needle samples and stem samples were collected from 56 whitebark pine and foxtail pine juveniles grown in MSU's plant growth center. Using gas chromatography mass spectrometry, we analyzed the concentrations of 41 compounds commonly found in white pine species for all samples collected. From the resulting dataset, we employed the Bray-Curtis dissimilarity equation to calculate a dissimilarity matrix. Subsequently, we ran a non-metric dimensional scaling analysis on this dissimilarity matrix to visualize rank-based distances in a two dimensional plot. Our NMDS analysis indicates that there is significant overlap of VOC compositions and concentrations between whitebark pine and foxtail pine, contrary to results from previous field studies. We suspect that this disagreement may be a result of several distinct factors such as the sensitivity of VOC production to climatic and environmental conditions. We also found significant overlap between VOCs of whitebark pine and the northern population of foxtail pine, but no overlap between VOCs of whitebark pine and the southern population of foxtail pine. Future research can investigate the potential causes of the differences in VOC compositions between the northern and southern populations of foxtail pine.

Acknowledgments: USP - Undergraduate Scholars Program

30

Does cover crop interseeding impact weed communities in organically grown carrots?

Reilly V Stack, Plant Sciences & Plant Pathology

Co-Authors(s): Sophie Lattes (LRES), Emma Kubinski (LRES), Mac Burgess

Mentor(s): Fabian Menalled, Land Resources & Environmental Sciences

Cover crops are a promising weed management tool with a variety of ecological benefits. However, there is a gap of knowledge regarding the effects of interseeded cover crops on weed communities, as well as the specific cover crop varieties most suitable for organic systems in Montana. A better understanding of these effects will allow organic producers to implement

integrated management practices more effectively. Therefore, this research investigates the impacts of interseeded cover crops on weed communities in organically grown carrot (*Daucus carota*). At the MSU Towne's Harvest Garden, we are evaluating changes in weed abundance and species composition across

interseeded annual ryegrass (*Lolium multiflorum*), berseem clover (*Trifolium alexandrinum*), summer alfalfa (*Medicago sativa*), and a control treatment without any cover crop. The experiment follows a randomized block design with four replications in 46' by 5' plots, with cover crops established on July 6, 2023. On August 9, 2023, we collected weed and cover crop biomass, and performed counts by species using 50 cm by 20 cm quadrats. Data analysis will include diversity indices, species richness, and community composition. Some preliminary observations suggest that plots containing cover crops have a significant reduction in weed density compared to the control. Further, it appears that certain weed species including common henbit (*Lamium amplexicaule*) have highly variable densities across treatments. The results of the study are anticipated to be completed by Fall 2024.

Acknowledgments: USP - Undergraduate Scholars Program

EDUCATION & HEALTH

POSTERS 31-41

31

Physical activity and its effects on inflammatory markers in at risk adults.

Mikynzi Jean Aylesworth, Health & Human Development

Co-Author/s: Katy Kropatsch, Health and human development/ nutrition

Mentor(s): Mary Miles, Health & Human Development

Authors: Mikynzi Aylesworth, Katy Kropatsch, Morgan Chamberlin, Stephanie M. Wilson, Marcie Gaston, Mary Miles Exercise affects fasting inflammatory markers, impacting the risk of chronic diseases. Higher inflammation increases this risk. Regular moderate-level exercise (3-6 METS) can have a protective effect on health, but it's unclear how it influences fasting inflammatory markers compared to a sedentary lifestyle. PURPOSE: Investigating physical activity's effects on fasting inflammatory markers in an at-risk population. METHODS: Participants, aged 29-69, with increased waist circumference (women >35", men >40"), wore accelerometers for 7 days (10 hours/day) during the first week of the 12-week study to measure daily physical activity levels, distinguishing between sedentary (10-minute bouts/day) and moderate/vigorous (10-minute bouts/day) activity levels. Cytokines (GM-CSF, TNF- α , IL-23, IL-1 β , and IFN- γ in mg/dL) were quantified using a high-sensitivity multiplex assay with Millipore kits and serum samples.

RESULTS: No significant differences (p -value>0.05) between GM-CSF, TNF- α , IL-23, IL-1 β , and IFN- γ levels and the average number of moderate/vigorous physical activity (MVPA) or sedentary physical activity (SPA). There was a weak inverse relationship between log MVPA and IL-6 (MV: β =-0.01160620 (p =0.645), Sed: β =0.002846 (p =0.237)), IFN- γ (MV: β =-0.0755857 (p =0.648), sed: β =0.009829 (p =0.536)), and IL-23 (MV: β =-0.1095827 (p =0.633), Sed: β =0.0006332 (p =0.773)). CONCLUSION: There was a weak association found between moderate/vigorous physical activity and decreased inflammatory markers.

Acknowledgments: USDA- ARS Pulse Crop Health Initiative 58-3060-9-040 and USDA-NIFA 2017-67018-26367.

32

Investigating the Positive Impacts of Fiber Content in Lentils on Satiety: a Randomized Controlled Trial

Coralee Marie Bock, Health & Human Development

Co-Author/s: Linsay Lee, College of Health and Human Development Chamberlin

Mentor(s): Mary Miles, Health & Human Development

The impact of dietary fiber on satiety could yield lasting health benefits for those vulnerable to chronic diseases. The influence of fiber on gastric emptying and its prebiotic effect on the gut microbiome may mitigate inflammation linked to metabolic disorders. Purpose: To understand the impact of insoluble fiber in lentils on satiety levels among individuals with an elevated body mass index (BMI). Methods: Adults (n =20) 18-65 with a BMI greater than 27 kg/m² consumed a control (40gFAT, 28gCHO, 13gPRO) or lentil pancake (40gFAT, 28gCHO, 13gPRO, 14gFIBER) in a randomized double-blind crossover study. Participants completed satiety surveys each hour (HR 0, 1, 2, 3, 4), and were asked to report fullness, desire to eat, and other questions on a scale of 0 to 10. Results: Fullness at HR 1 had a significant difference between groups (p =0.042), with the lentil group reporting increased fullness. Desire to eat at all hours and fullness at hours 0, 2, 3, and 4 had no significant differences between groups. Conclusion: We conclude that at 1 hour post-meal fullness was slightly increased in the lentil group. Dietary fiber content offers the potential to enhance short-term satiety and lower metabolic disease risk. Further research comparing dosage of fiber is needed to provide more comprehensive understanding of the relationship between dietary fiber, satiety, and metabolic health.

Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)

33

Postprandial Lipoprotein Response between Beef and Lentil Meals

Caleb Neal Brownell, Health & Human Development

Co-Author/s: Meghan Spears, Health and Human Development M,

Mentor(s): Mary Miles, Health & Human Development

Introduction: High levels of TG and CHOL can lead to increased risk of stroke and cardiovascular disease due to a build-up of plaque on the arterial walls. High levels of HDL have been shown to decrease the risk of cardiovascular disease. Animal based and alternative proteins sources are debated in literature relating to the effect on postprandial human health. The purpose of this study is to examine the effect of a lentil-based meal (LEN) versus an organic grass-fed steak meal (GRA) on postprandial lipoproteins. Methods: Men and Women aged 21- 63 (n=33) were given a LEN based pancake or GRA 6 oz. steak and blood samples were taken at fasting and every hour for 4 hours postprandially. Lipoproteins were then assessed using a lipid panel (Piccolo Abaxis). Net area under the curve (AUC) was calculated for statistical analysis. Results: Between meal interventions, HDL responses were similar (p=0.41), but cholesterol (p=.063) and triglycerides (p<0.001) were higher in LEN. Discussion: This shows that a LEN based meal has a larger impact on lipoprotein levels compared to a GRA steak. This could be due to the increased cholesterol content in the LEN pancake, which contained 49g of butter. Support is provided by USDA-NIFA 2017-67018-26367 and OAEC.

Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)

34

Influence of Kinship Caregiver and Family Characteristics on Kinship Care Experiences

Ayomide Foluso, Health & Human Development

Co-Author/s: Brianna Routh & Mark Schure Health & Human Development

Mentor(s): Brianna Routh, Health & Human Development

Kinship care is the increasingly preferred child placement with a relative when the biological parents are unable. Program and resource supports must understand how to best meet these caregivers' needs. Through thematic analysis of existing literature, this study aims to understand how kin caregiver characteristics impact kinship care outcomes. A total of 28 peer-reviewed articles were included in this analysis. Findings indicate caregiver characteristics including racial differences, family roles, economic burden, structural supports, and caregiver health have potentially differential impacts on kinship care and outcomes. Identifying these characteristics indicates the importance of considering flexibility and adaptability of policy, programming, and research to meet the needs of kinship families with diverse characteristics instead of viewing this as a homogenous population. Incorporation of these characteristic considerations may lead to more effective and impactful supports and improved well-being for all kinship families.

Acknowledgments: This work was supported by Montana Department of Public Health and Human Services (grant number 20213IVEE0001)

35

An Investigation of Patient Experiences When Seeking Care for Müllerian Anomalies in Montana

Nicole M Holt, Health & Human Development

Mentor(s): Miranda Margetts

The purpose of this research is to examine the patient experience of those diagnosed with Müllerian Anomalies (MAs) in Montana. MAs are congenital uterine anomalies that occur in about seven percent of the female population and can cause pelvic pain, prolonged bleeding, and sub- and infertility. Patients with MAs often require specialized care throughout their lives, which can be a challenge due to the rurality of Montana. For this research, thirteen patients from across Montana were interviewed, and their responses to all questions asked were analyzed to determine key themes. Both audio recordings and written transcriptions of the interviews were used. This work builds off the work done in the summer of 2023, where only the question “While you have lived in Montana, could you please describe any challenges you have experienced in accessing care for your condition? This includes distances to travel for appointments and availability of appointments. If so, how have these challenges impacted your day-to-day activities, e.g., attending to school, work, social and family obligations?” was analyzed. It was found that common problems included long travel distances to see providers, issues with health insurance, and negative impacts on patients’ careers. The findings will contribute to a broader understanding of the patient experience in Montana and inform strategies to enhance care and support for those with MAs. This research aligns with ongoing projects aimed at improving healthcare for rural women with complex gynecological conditions and identifying health information gaps for patients with MAs.

Acknowledgments: USP - Undergraduate Scholars Program, INBRE - IDeA Network for Biomedical Research Excellence, McNair Scholars Program

36

IMU Validation from 3D Motion Capture

Macie J Hopkins, Health & Human Development

Co-Author/s: Owen Comes, James Becker & Ashlyn Baird, EHHD

Mentor(s): Jim Becker, Health & Human Development

Though few studies have explored running mechanics outside of the laboratory, the validity of Inertial Measurement Units (IMU) to measure joint kinematics while running outdoors has not yet been shown. This study compared knee kinematics during uphill running when using 3D motion capture (gold standard) and IMU systems. One participant completed an 8-stage uphill VO₂max Test. Motion Capture (Mocap) and IMU data were collected to calculate knee flexion at heel strike (KFHS), peak knee flexion during stance (PKF) and knee flexion ROM (KFROM). Differences in knee kinematics between measurement systems and across grades were evaluated using a 2x5 repeated measures ANOVA, with statistics performed using the Statistical Package for the Social Sciences (SPSS, IBM Corp. Armonk, NY). For KFHS there was a stage x measurement interaction ($F_{4,32}=156.96$, $p<.001$). At all inclines except for 14%, the IMU overestimated KFHS (all $p < .001$). However, at 14% grade there was no difference between Mocap ($24.7 \pm 3.2^\circ$) and IMU ($27.1 \pm 2.7^\circ$) estimates ($p = 0.111$). Similar interactions were observed for PKF ($F_{4,32}=508.62$, $p<.001$), with the mocap system reporting less PKF at all inclines than the IMU, except for at 14% grade. However, at 14%, the IMU system reported less PKF ($46.3 \pm 2.1^\circ$) than the Mocap ($64.1 \pm 0.7^\circ$). There was also a stage x measurement type interaction ($F_{4,32}=169.01$, $p<.001$) for KFROM. At grades of 12% and 14%, there were no differences between Mocap and IMU data. However, at higher grades the IMU reported less KFROM. These findings agree with previous studies showing that IMUs cannot reliably measure knee kinematics.

The offset could be accounted for when considering the effects of grade using a dynamic calibration of the IMU. Therefore, the validation of IMU systems requires further investigation.

Acknowledgments: Other funding or support

37

Continued Professional Development among Secondary Agricultural Education Teachers in Uganda, a case study.

Brian Kibirige, Department of Agricultural and Technology Education

Mentor(s): Dustin Perry, Agricultural & Technology Education

In 2020, the Ministry of Education and Sports in Uganda rolled out a Competence-Based Curriculum (CBC) for the lower secondary school level. With 21 subjects on its subject menu, the new curriculum was designed to provide practical and meaningful education to young Ugandans as a means of addressing the much-needed 21st-century skills or skills needed in the world of work. Education commentators mention that this curriculum is the right step in the right direction for the socio-economic transformation of Uganda. However, past research indicates that many Ugandan secondary teachers don't have the pre-requisite pedagogical skills to teach a CBC. As such, the purpose of this study was to identify the existing professional needs among Ugandan secondary agricultural education teachers and provide recommendations for the provision of high-quality Continuous Professional Development (CPD) training. This concurrent mixed methods study with 52 participants collected data on teachers'; subject content proficiency, pedagogical competency, Continuous Professional Development (CPD) needs, and personal Biodata. Results indicated that 88% of participants were male and 12% were female. 38% had an associate degree (diploma), 48% had a bachelor's degree and 13% had a master's degree in agricultural education. Participants taught in rural (33%), peri-urban (44%) and urban (23%) schools. The average participant was a male teacher with 3.7 years of teaching experience and with a bachelor's degree in agricultural education. 67.3% of participants were at the developing level in regard to subject content proficiency. All participants echoed that available CPD training was of high quality (M=4.25) and identified 17 key areas of CPD training needs. As such, training in subject content areas was ranked the highest (M=4.37) and curriculum mapping ranked the lowest (M=4.00). Lastly, teachers prefer attending CPD training in-person and with hands-on participation (M=4.38) and organized before the first day of each academic term (M=4.23). Ugandan secondary agricultural education teachers need to participate in high-quality CPD training programs for better implementation of the new lower secondary curriculum. To achieve this, the government of Uganda needs to operationalize the National Teachers Policy and fund the Continuous Professional Development Framework of 2018. Additionally, school leaders and other stakeholders need to organize CPD training at the school, regional, and national levels to increase the accessibility of such training to their teachers. If done well, teachers of agricultural education will attain professional development and in turn lead to achievement of high academic outcomes among their learners regardless of their school location.

38

Anthropometric Predictors of Postprandial Glucose Response After a High Fat Meal

Reese Doreen Meyer, Health & Human Development

Co-Author/s: Lindsay Lee & Morgan Chamberlin, Health and Human Development

Mentor(s): Mary Miles, Health & Human Development

Elevated postprandial (pp) glucose (GLU) indicates impaired metabolic health. Elevated glucose responses after a high-fat meal can result in pp Hyperglycemia. Visceral adiposity impairs metabolic health by

contributing to hyperglycemia. Consistent pp hyperglycemia can increase metabolic disease risk, especially in individuals with elevated waist circumference. **PURPOSE:** To investigate the contribution of visceral adipose tissue (VAT) and fasting GLU to ppGLU iAUC in response to a high-fat meal in adults with central obesity. **METHODS:** Adults (n=42) aged 18-70 years with elevated waist circumference (106.6 +/- 13.9 women), (117.43 +/- 0.66 men) (mean +/- SD) completed a high-fat meal challenge (50g FAT, 54g CHO, 12g PRO) with blood collected at fasting and hourly time points for 5 hours postprandially. Serum GLU was summarized as iAUC (GLUiAUC). Bioelectrical impedance analysis was used to measure VAT. Linear modeling determined which physiological measures contributed most to ppGLU response. **RESULTS:** Fasting GLU was the strongest predictor of GLUiAUC response ($p < 0.0001$), with a decrease in ppGLU observed with increasing fasting GLU. VAT did not predict GLUiAUC ($p = 0.645$). **CONCLUSION:** In individuals with increased waist circumference, ppGLU was best predicted by fasting glucose and was not predicted by VAT. These findings underscore the significance of lowering fasting GLU to mitigate metabolic disease risk.

Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)

39

Negative Association Between Phase Angle and Age, FMI

Gianna Migliaccio, Microbiology & Cell Biology

Co-Author/s: Meghan Spears, Health and Human Development

Mentor(s): Mary Miles, Health & Human Development

Phase angle (PhA) is a measurement that provides information about the general health of a person's somatic cells. It is a measurement of resistance and reactance to the flow of an electrical current sent through the body. The purpose of this study was to explore the association between fat mass index (FMI), age, and PhA in adults with a BMI above 22.5 kg/m² and waist circumference more than 35 inches (women) and 40 inches (men). In contrast to BMI, which is calculated by dividing a person's weight in kilograms by their height measured in meters squared, FMI is calculated by dividing a person's fat mass by their height squared. It is hypothesized that heightened FMI and age will be negatively associated with phase angle. Sixty-four participants (n = 64; m = 1, f = 63; age, 44 ± 12.57 years) underwent bioelectrical impedance analysis (BIA) to collect anthropometrics. Weight, BMI, and visceral adipose tissue data were measured using BIA. No association or statistical significance was observed. When participants were placed in high PhA (> 5.2) and low PhA (≤ 5.2) groups, an inverse relationship was observed between age and PhA ($p = 4.84 \times 10^{-5}$) as well as FMI and PhA ($p = 0.010$). These findings suggest age and body composition, specifically fat mass, may impact PhA, which has implications for aging obese individuals. Support is provided by the United States Department of Agriculture ARS Pulse Crop Health Initiative 58-3060-9-040.

Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)

40

The Impact of Revised Curriculum on English Language Teaching

Enkhchimeg Sharav, Education

Mentor(s): Sarah Pennington, Education

The Mongolian educational system has undergone a series of reforms with a complete overhaul occurring frequently. This study examines English language education in Mongolia, and the challenges English

language teachers face in relation to English core curriculum revisions. These challenges are explored through the lens of the teachers' experiences and perspectives. Research participants addressed challenges in both face-to-face and virtual teaching contexts and shared their insights regarding the current situation of English language education, the professional development programs for in-service teachers, and their experiences with implementing the core curriculum in their classrooms. This study integrates a thorough literature review with interviews of five English language teachers in Mongolia. Key findings from the interviews revealed that the main challenges participants encountered in meeting the expectations of the curriculum were due to traditional teaching approaches, lack of virtual teaching experience, and additional non-instructional workload. Based on the findings and insights, it is recommended that there is a need to foster effective professional development for the improvement of teacher instruction, modifying teaching approaches in line with the expectations of the updated curriculum outcomes and eliminating non-teaching workload to allow teachers more opportunities for professional growth and mastery.

Acknowledgments: EHHD travel scholarship and Education Department Travel funding

41

Mathematics Teachers' Conceptions of The Theory Of Multiple Intelligences In Ghana

Sumaila Yakubu, Education

Co-Author/s: Michael Nabie

Mentor(s): Fenqjen Luo, Education

The study investigated the Ghanaian mathematics teachers' conceptions of the theory of multiple intelligences (MIs) using a basic qualitative method design. Participants included (12) senior high school mathematics teachers in one municipality of Ghana. Questionnaires and semi-structured interviews including field notes provided information on mathematics teachers' conceptions of the theory. Qualitative data obtained was analyzed thematically. The results indicated that mathematics teachers conceived the theory of MIs as a theory of abilities for learning, multiple teaching strategies, and a theory for diverse needs.

Acknowledgments: EHHD Student Travel Grant

MATH, ENGINEERING & TECHNOLOGY

POSTERS 52-53

42

Engineering Biodegradable Plastics Through Thermophilic Value Added Polyhydroxyalkanoates

Taylor Marie Carey, Chemical & Biological Engineering

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Mentor(s): Brent Peyton & Dana Skorupa, Chemical & Biological Engineering

Thermus thermophilus strain HB8, a known PHA producer, will be tested for growth on partially oxidized plastic wastes produced through preliminary cracking and oxidation of LDPE plastic wastes. This research focuses on maximizing thermophilic microbial growth on oxidized plastic wastes and aims to explore potential thermophilic production of value-added bioplastics. The research will initially determine if Thermus thermophilus HB8 can use oxidized petroleum-based plastics as its main carbon source since it has been shown in our lab to produce PHA. It is estimated that plastics contribute up to 80% of marine debris causing serious environmental and health problems worldwide and the use of oxidized plastic wastes may offer an alternative for PHA bioproduction. The goal of this project is to identify one or more thermophiles capable of degrading oxidized plastic waste and potentially produce value-added polyhydroxyalkanoate (PHA) bioplastics. Other results showed T. thermophilus HB8 tested under nitrogen-limited conditions could produce PHAs using glucose as its sole carbon and energy source. This test was found to successfully grow and produce PHA, indicating that this thermophile could be a promising isolate for downstream testing on chemically/catalytically deconstructed plastic materials. Growth rates will be assessed using optical density measurements at 600 nm. Partially degraded plastic wastes will be incorporated as sole carbon source for growth, with downstream extraction and analysis examining PHA production levels.

Acknowledgments: USP - Undergraduate Scholars Program

43

Fabrication of Flexible Transistors via Additive Manufacturing

Joseph Anthony DiGrappa, Mechanical & Industrial Engineering

Mentor(s): Yang Cao, Mechanical & Industrial Engineering

Transistors are a crucial component within most modern day electronics. Modern day transistor manufacturing techniques require a lot of post-processing and have limited opportunity for customization. Additive manufacturing can be used to manufacture transistors that are highly customizable without the need for post-processing. In this research, the additive manufacturing technique of inkjet printing was implemented to fabricate a flexible transistor by printing the transistor layer by layer with different inks. Unfortunately, the inkjet printing process was unsuccessful due to reoccurring technical and mechanical issues that came for the printers used. While inkjet printing via a commercial printer was found to be unsuccessful, the next step for testing of additive manufacturing involves a modified FDM 3D printer that extrudes the inks in a way that allows for easier troubleshooting and repairs if problems arise.

Acknowledgments: USP - Undergraduate Scholars Program

44

An Application of Constrained Linear Least Squares to Estimate Metabolomic Reaction Rates

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Co-Author/s: Ron June & Brady Hislop, Mechanical & Industrial Engineering

Mentor(s): Dominique Zosso, Mathematical Sciences

Cellular metabolism is believed to be important in the development of osteoarthritis, a debilitating and degenerative disease. Cellular metabolism can be assessed through the measurement and analysis of the metabolomic profile, composed of the small molecule reactants, products, and bi-products from cellular metabolism. Our group studies the impact of cyclical compression, like walking, on cartilage cell metabolism. To understand the impact of joint loading on metabolic reaction rates, we consider a stoichiometric fitting problem on 80 datasets. For a set of N reactions with rates in $v \in \mathbb{R}^N$, there are resulting measured changes in a set of M metabolites, recorded in $b \in \mathbb{R}^M$. These measured changes are calculated using the flux analysis data from the Liquid Chromatography-Mass Spectrometry (LC-MS) process. The reactions are encoded in the stoichiometric $M \times N$ matrix, S , each column of which corresponds to one reaction (n) and the different rows (m) contain coefficients indicating relative amounts of reactants ($s_{mn} < 0$) and products ($s_{mn} > 0$). The goal is to estimate from partial and noisy measurements b , the underlying reaction rates v that best explain the measurements: $Sv = b$, where S is the stoichiometric matrix, v are unknown reaction rates, and b are observed net changes in metabolites. We solve this problem with quadratic programming in MATLAB, given reversibility constraints on the reactions. Preliminary results will be presented.

Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)

45

Organic Memristor

Ben O Kindgren, Mechanical & Industrial Engineering

Mentor(s): Yang Cao, Mechanical & Industrial Engineering

This study is an exploration of material options for the fabrication of an organic memristive device, emphasizing the efficiency, flexibility, and sustainability that organic electronic devices offer in the current technological landscape. The research involved a detailed investigation of three distinct materials: gelatin, glucose, and lignin. To initiate this investigation, we devised a spin coating method to uniformly deposit these organic materials onto conductive ITO (Indium Tin Oxide) slides, ensuring a high degree of control over layer thickness. This method offers significant advantages in terms of scalability, cost-effectiveness, manufacturability. In addition to the practical fabrication process, we tested each material's electrical properties by generating voltage/current curves. This assessment allowed us to evaluate and compare the memristive behavior, resistance, and switching characteristics of gelatin, glucose, and lignin. Furthermore, our findings reveal intriguing insights into the performance variations and potential suitability of these materials for memristive devices. This research contributes to the growing body of knowledge surrounding organic electronics and offers a foundation for further investigations at MSU and the development of innovative, sustainable technology solutions.

46

Spatiotemporal Forecasting of High-Resolution Evapotranspiration Data in Agricultural Fields Using Tensor Decomposition

Farshina Nazrul Shimim, Electrical & Computer Engineering

Co-Author/s: Jacob Munson, Mathematical Science

Mentor(s): Bradley Whitaker, Computer Engineering & Dominique Zosso, Mathematical Sciences

Plant evapotranspiration is a vital element for making efficient irrigation decisions using precision agriculture. This project aims to predict high-resolution spatial Evapotranspiration (ET) data for an agricultural field using a dataset comprising of multispectral aerial imagery collected weekly/biweekly, daily point-based in-situ ET sensor measurements from specific locations in the field and the corresponding meteorological data. Hence, in the spatiotemporal dataset, there are gaps in spatial information for each non-aerial imagery data collection day and gaps in the temporal information for all locations in the field that do not have in-situ sensors. Therefore, the objective of this project is to fill these gaps using statistical methods. In this regard, we modeled the data as a recommender system (a partially observable 2D matrix where each row corresponds to the spatial information of the field and each column corresponds to a day in the growing season) and implemented low-rank tensor approximation techniques to fill the spatiotemporal gaps in the dataset. Successful predictions could aid farmers, especially in drought-prone areas, in making efficient irrigation decisions and optimizing plans days in advance, potentially reducing the need for frequent image collection flights.

Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)

47

Clustering Flow Cytometry Data With Gaussian Mixture Models

Benjamin C Vogel, Mathematical Sciences

Mentor(s): Breschine Cummins & Dominique Zosso, Mathematical Sciences

Flow cytometry fluorescence data were collected to evaluate the performance of a synthetic biology logic circuit embedded in the yeast genome (Cummins et al., 2023). This data, however, became contaminated in the data collection process, specifically the negative control became contaminated making analysis very difficult. There were two main potential sources of contamination which were the two positive controls. Previously, this data was salvaged by separating the bimodal distributions present by using a random forest classifier. This current work's aim is to improve the separation and clustering by using Gaussian mixture models (GMM), to provide a richer source of information as compared to the random forest classifier. The gaussian mixture models should also give more insight into the potential sources of contamination. We fit the models with both all 16 information channels from our flow cytometry data as well as a reduced number of channels to focus specifically on fluorescence. We found that when all 16 channels were used our GMMs became dominated by the forward and side scatter channels which is associated with cell size. By reducing the variables, we found separation on fluorescence channels which gave us useful results. Of the two possible sources of contamination, we considered, the w303 positive control was far more likely the culprit based on the reduced GGM modelling process. Though these initial results are promising, additional work needs to be done to draw more concrete conclusions.

Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)

48

Designing a Towing Tank Facility for Wake Vortex Experiments

Taylor Wehausen, Mechanical & Industrial Engineering

Mentor(s): Sarah Morris & David Nelson, Mechanical & Industrial Engineering

Counter-rotating wake vortices are an unavoidable byproduct of lift behind fixed-wing aircraft. These vortices create unstable air and pose a hazard to following aircraft; this hazard is particularly prevalent near the ground where there is insufficient altitude to recover. This hazard led to the FAA implementing regulations on wait times for aircraft during take off. The wait time determines the maximum number of aircraft that can be traffic through an airport. If the decay of these vortices could be accelerated, then the wait time for aircraft would be reduced, allowing more airplanes to be trafficked through an airport. Counter-rotating vortex pairs can be generated in the laboratory behind a delta wing either by placing it in a water channel, or by towing it in a towing tank. The objective of this project is to design a towing tank facility dedicated to wake vortex experiments. One of the primary aims of this project is to improve upon previous studies' delta wing mounts to facilitate a cleaner setup for the delta wings, and to make adjusting the angle of attack of the delta wing easier. The towing tank must have the capability to pull the delta wing carriage (15kg) at 0.2 m/s. Various methods of the towing tank were brainstormed and assessed based on factors such as budget and ease of setup. The towing tank was then modeled in CAD (Fusion 360) with all the components mated correctly along with their corresponding movements. The CAD model ensured an accurate setup of the tank and that all the components were compatible. This completed design will allow the facility to be built and ensure that wake vortices can be studied accurately and consistently.

Acknowledgments: USP - Undergraduate Scholars Program

MICROBIOLOGY & CELL BIOLOGY

POSTERS 49-51

Alternative approach for antibiotic susceptibility determination in Mycoplasma biofilms

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Co-Author/s: B. Tegner Jacobson, McKenna Quirk & Jessica Dewitt, Microbiology & Cell Biology

Mentor(s): Diane Bimczok, Microbiology & Immunology

Mycoplasma bovis is a pathogen associated with bovine respiratory disease. *M. bovis* can form biofilms in vitro, which are associated with antibiotic resistance in many other biofilm forming organisms. A decrease in acid production has also been observed in *M. bovis* biofilms, which makes interpretation of the standard microdilution antibiotic susceptibility assay difficult. We propose an alternative approach for antibiotic susceptibility testing in biofilm-forming *Mycoplasma* that utilizes flow cytometry to determine the percentage of live and dead organisms. A reference strain, *M. bovis* (ATCC 25523) was used for the development of the live/dead percentage assay. Three methods were compared to homogenize biofilm particle size. *M. bovis* biofilms were disrupted via 0.01% Tween-20, 0.2% Pluronic F-68, or sonication then stained with SYTO9. The stained cells were analyzed with flow cytometry to ensure treatment did not negatively affect cell viability and imaging cytometry was used to determine particle size of the disrupted biofilms. To perform the live/dead percentage assay, both planktonic cells and newly adhered biofilms were subjected to a range of broth microdilutions for either gentamicin, enrofloxacin, or gamithromycin, incubated for 7 days, and then were stained with SYTO9 and propidium iodide. The stained cells were then analyzed with flow cytometry to determine the minimum inhibitory concentration (MIC). *M. bovis* biofilm maturation was quantified by incubating a known planktonic cell concentration for 7 days, and determining percent confluence of the biofilm via microscopy and image analysis.

Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)

50

Assessing the impact of Baytril treatment on Mesomycoplasma ovipneumoniae-infected sheep

Sobha Sonar, Microbiology & Cell Biology

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Mentor(s): Diane Bimczok, Microbiology & Immunology

Mesomycoplasma ovipneumoniae is a well-established respiratory bacterium that leads to pneumonia and reduced productivity in domestic sheep. At present, there are no antibiotic treatments to completely address this disease in the United States. Our study aimed to assess the treatment effects of the antibiotic-enrofloxacin (Baytril®), in domestic sheep experimentally infected with *M. ovipneumoniae*. Ten 4-month-old specific-pathogen-free lambs were randomly assigned to two groups, a treatment, and an untreated control group. Lambs were inoculated with fresh nasal wash fluids from *M. ovipneumoniae*-positive sheep and monitored for four weeks. The treatment group then received Baytril at a dose of 0.5mg/kg in 200 mL of saline as a nasal wash and 5mg/kg subcutaneously for 5 days, whereas the control group did not receive any treatment. All ten lambs were observed for an additional four weeks. Daily health scoring, weekly assessment of weight gain, and nasal swab qPCR were conducted throughout the research period to detect *M. ovipneumoniae* colonization in all animals and treatment efficacy in the treatment group. We found a significant improvement in the health score and weight gain and a trend of reduced lung pathology in the treatment compared to the control group. All lambs tested negative for *M. ovipneumoniae* after the first week of the treatment. However, there was a re-emergence of infection after the second week of treatment. The mechanism for this reemergence is unknown. Therefore, our

study will further focus on the investigation of inaccessible anatomical sites such as the middle ear and paranasal sinuses as bacterial reservoirs.

Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)

51

Generation of Thiols via Pyridoxal Phosphate-Dependent Pathways in Absence of Disulfide Reduction

Zoe M Seaford, Microbiology & Cell Biology

Mentor(s): Ed Schmidt, Microbiology & Immunology

Research in the Schmidt Lab focuses on the reduction of cellular oxidants through thiol oxidation, particularly under conditions of oxidative stress. Investigations focus on the role of sulfur-containing methionine and cysteine amino acid metabolism in maintaining cellular redox balance. To quantify whole sulfur flux through metabolic pathways, we employ in vivo isotopic tracing in mouse models, enabling direct comparison between normal liver and mutant livers lacking the antioxidant enzymes Thioredoxin Reductase-1 and Glutathione reductase (TR/GR null). These models, exemplified by TRGR-null livers, are relevant for studying oxidative stress conditions. The enzymes, cystathionine β -synthase (CBS) and cystathionine γ -lyase (CSE), can both form and cleave carbon-sulfur (C-S) bonds of amino acids including cystathionine, serine, cystine, homocysteine, and others. Here we assessed the functionality of these enzymes in a pathway that generates cysteine from cystine via an initial C-S bond cleavage in Wildtype (WT) and TR/GR-null mice. We hypothesize that TR/GR-null but not WT livers depend on CBS and CSE activity for survival. Utilizing isotopically labeled amino acids, we traced sulfur, carbon, and nitrogen atoms from cystine or serine. These labeled amino acids were infused via jugular catheters in WT and TR/GR-null mice, with half of the mice from each genotype receiving the inhibitor aminooxyacetate (AOAA) to block PLP-dependent enzymes CBS and CSE. Mass spectrometry was used to quantify heavy cystathionine, cysteine, and glutathione containing products. Metabolic flux analyses revealed a large reduction in production of cysteine in WT livers of animals treated with AOAA and abrogation of cysteine production in TR/GR-null livers treated with AOAA. This reveals a crucial role for CBS and CSE in maintaining cysteine production under stress conditions wherein disulfide reductases are deficient.

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Federal funding through your research mentor (NSF, NIH, NASA, DOE, etc.)

PHYSICS & SPACE SCIENCE

POSTERS 52-53

52

Mapping the Edge of the Magellanic Stream

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Tapasi Ghosh, Christopher Salter & Robert Minchin

Mentor(s): David Nidever, Physics

The Magellanic Stream dominates the HI landscape in the southern sky. Despite this, the exact extent of its coverage is unknown due to the dispersed nature of the gas comprising its tip. Previous measurements have put the length of the Stream near 140° , but the discovery of a compact high velocity cloud in de Heij et al. (2002) matching the profile of HI in the Magellanic Stream suggests the Stream may cover a further extent. We present new observational evidence reuniting CHVC 424 with the Magellanic Stream, increasing the Stream's known length to 155° , and the overall length of the Magellanic System beyond 200° . This addition pushes the extent of the Magellanic Stream beyond the Milky Way mid-plane, a key benchmark for modeling the orbital history of the Milky Way/Magellanic Cloud System. The HI data used in this project spanned 300 square degrees covering part of the edge of the known Magellanic Stream out towards CHVC 424, and was obtained through 435 hours of observing time on the 100-m Green Bank Telescope.

Acknowledgments: MSGC - Montana Space Grant Consortium

53

A Search for HI Emission in Galaxies at $z < 0.06$ using the GBT L-Band Drift Scan Survey

Mahpara Tasnim, Physics

Co-Authors: Tapasi Ghosh, Christopher Salter, Robert Minchin, and Kimberly Emig

Mentor(s): Pedro Salas, Physics

Cold neutral atomic hydrogen (HI) is an important constituent of the Interstellar Medium (ISM) of spiral and irregular galaxies. It is detectable through its 21-cm line emission by radio telescopes, and helps us study galaxies more efficiently even through regions of high dust obscuration in optical wavelengths. Blind L-band surveys can help detect the 21 cm HI line, enabling us to study the spatial and spectral properties of external galaxies. This project examines HI emission at 21 cm using the Green Bank Telescope L-band Drift Scan Survey. The survey has observed 7000 square degrees of the sky, but here we focus on a smaller area in order to establish calibration and detection methodology for the entire survey. We found two cases of extragalactic emission at redshifts $z = 0.02$ and $z = 0.05$ which justifies the validity of our method of data-analysis. We also present motivation to undertake a follow-up study of our detected sources at different wavelengths which can provide us with more information about their star formation rates.

Acknowledgments: Other funding or support

ALPHABETICAL LIST OF PRESENTERS

POSTERS 1- 54

ALPHABETICAL LIST OF PRESENTERS

POSTERS 1-54

LAST	FIRST	TITLE	POSTER	PAGE
Anderson	Ian	<i>Restoration of a 19th-Century Clarinet</i>	01	02
Aylesworth	Mikynzi	<i>Physical activity and its effects on inflammatory markers in at risk adults.</i>	31	20
Bishop	Storrs	<i>Wearing Survivance</i>	02	02
Bock	Coralee	<i>Investigating the Positive Impacts of Fiber Content in Lentils on Satiety: a Randomized Controlled Trial</i>	32	20
Brown	Ross	<i>The Effect of Western Culture on Native American Art</i>	03	03
Brownell	Caleb	<i>Postprandial Lipoprotein Response between Beef and Lentil Meals</i>	33	21
Carey	Taylor	<i>Engineering Biodegradable Plastics Through Thermophilic Value Added Polyhydroxyalkanoates</i>	42	27
Chwalik	Erica	<i>Mapping the Edge of the Magellanic Stream</i>	53	35
Clark	Brendan	<i>Digital Rendering of a Unique Turtle Specimen from the Blackleaf Formation, Montana</i>	23	14
DiGrappa	Joseph	<i>Fabrication of Flexible Transistors via Additive Manufacturing</i>	43	27
Dovsky	Questian	<i>Diné and Haida Weaving: Enduring Symbols</i>	04	03
Dusbabek	Gracie	<i>Beyond Fashion: The REDress Project</i>	05	04
Foluso	Ayomide	<i>Influence of Kinship Caregiver and Family Characteristics on Kinship Care Experiences</i>	34	21
Friedman	Alex	<i>Who New?</i>	06	04
Heespelink	Miles	<i>Environmentalism in Native American Art</i>	07	05
Holt	Nicole	<i>An Investigation of Patient Experiences When Seeking Care for Müllerian Anomalies in Montana</i>	35	22
Hopkins	Macie	<i>IMU Validation from 3D Motion Capture</i>	36	22
Kibirige	Brian	<i>Continued Professional Development among Secondary Agricultural Education Teachers in Uganda, a case study.</i>	37	23
Kimmel	Aubre	<i>An Application of Constrained Linear Least Squares to Estimate Metabolomic Reaction Rates</i>	44	28
Kincy	Sarah	<i>Creating Hydraulic Vulnerability Curves for Two-Year-Old Limber Pine and Ponderosa Pine Seedlings</i>	24	14
Kindgren	Ben	<i>Organic Memristor</i>	45	28
Kroening	Toby Allan	<i>The Cultural Differences Within the Use of Beadwork</i>	08	05
Light	Logan	<i>USING SANIDINE TRACE ELEMENTS TO DISCERN BETWEEN TWO RHYOLITIC UNITS IN YELLOWSTONE NATIONAL PARK</i>	25	15

Light	Logan	<i>Deciphering the Thermal History of the Great Valley Forearc Basin at del Puerto Canyon, California</i>	26	15
McCarthy-Rogers	Mandi	<i>Appropriation vs. Appreciation</i>	09	05
McGrath	Courtney	<i>Native American Silversmithing Techniques Anthropometric</i>	10	06
Meyer	Reese	<i>Predictors of Postprandial Glucose Response After a High Fat Meal</i>	38	23
Migliaccio	Gianna	<i>Negative Association Between Phase Angle and Age, FMI</i>	39	24
Nazrul Shimim	Farshina	<i>Spatiotemporal Forecasting of High-Resolution Evapotranspiration Data in Agricultural Fields Using Tensor Decomposition</i>	46	29
O'Borsky	Erica	<i>Buy Your Turquoise From Native Artists</i>	11	07
Palmer	John	<i>Justin Jacob Louis</i>	12	07
Pasternak	Zoey	<i>The Pith(y) Solution of Wheat Stem Sawfly in Durum Wheat</i>	27	16
Peck	Megan	<i>Significance of Gender in Traditional and Modern Diné Fashion</i>	13	07
Reitan	Jessica	<i>Indigenous Futurism in Fashion</i>	14	08
Robinson	Oskar	<i>Evaluating drought stress between high-elevation five needle pines: <i>Pinus albicaulis</i> and <i>P. flexilis</i></i>	28	16
Seaford	Zoe	<i>Generation of Thiols via Pyridoxal Phosphate-Dependent Pathways in Absence of Disulfide Reduction</i>	49	32
Selong	Eli	<i>Alternative approach for antibiotic susceptibility determination in <i>Mycoplasma</i> biofilms</i>	50	32
Sharav	Enkhchimeg	<i>The Impact of Revised Curriculum on English Language Teaching</i>	40	24
Sonar	Sobha	<i>Assessing the impact of Baytril treatment on <i>Mesomycoplasma ovipneumoniae</i>-infected sheep</i>	51	33
Speirs	Benjamin	<i>Comparison of VOC Compositions of Two High Elevation Five Needle Pines</i>	29	17
Stack	Reilly	<i>Does cover crop interseeding impact weed communities in organically grown carrots?</i>	30	17
Tasnim	Mahpara	<i>A Search for HI Emission in Galaxies at $z < 0.06$ using the GBT L-Band Drift Scan Survey</i>	54	35
Thomas	Annamarie	<i>Redesigning Native Fashion: Wendy Red Star</i>	15	08
Tromans	Olivia	<i>Anthropological Effects on Native Cultures</i>	16	09
Tuggey	Jessica	<i>Rebecca Belmore: Life and Art</i>	17	09
Vogel	Benjamin	<i>Clustering Flow Cytometry Data With Gaussian Mixture Models</i>	47	29
Walker	Makena	<i>Native American Southwestern Turquoise and Silversmithing</i>	18	10
Wehausen	Taylor	<i>Designing a Towing Tank Facility for Wake Vortex Experiments</i>	48	30

Weise	Ella	<i>Frankie Welch</i>	19	11
Wern	Charles	<i>Polar Clothing Techniques and Production</i>	20	11
Whisler	Austin	<i>The History of Music (Abridged)</i>	21	11
Yakubu	Sumaila	<i>Mathematics Teachers' Conceptions of The Theory Of Multiple Intelligences In Ghana</i>	41	28
Yoshimura	Yufu	<i>A Global Inventory of Double Reed Instruments: A Cultural Perspective</i>	22	12