MAINE 2021 Student Symposium

Research and Creative Activity

Book of Abstracts

Table of Contents

UMSS21 Book of Abstracts
Presentation List by Category

Physical and Mathematical Sciences - Pgs. 52 - 62

101. Luminosity Functions of Galaxy Clusters in the Aquarius and Microscopium Superclusters

- Logan Hess
- David Batuski

102. Exchange Functionals and Basis Sets for Density Functional Theory Study of ZnO Nano clusters in Photocatalytic Reactions

- Duwage Perera
- Jayendran C. Rasaiah

103. Characterization and Modification of Cellulose Nanofibrils for Green Composites

- Peter Kelly
- William Gramlich
- Douglas Gardner

104. Application of Machine Learning Techniques to Classify and Identify Galaxy Merger Events in the CANDELS Fields

- Alex Koch
- David Batuski

105. Surface Modification of Cellulose Nanofibrils Using Water Soluble Monomers and Subsequent Surface Polymer Characterization

- Peng Cheng
- Peter Kelly
- William Gramlich

106. Analyzing Nonsmooth Sensitivities in Graph Centrality Problems

- Jon Donnelly
- Peter Stechlinski

107. The Impact of Natural Rubber as a Toughening Agent on the Strength, Degradability, and Toxicity of an Algae-Based Bioplastic

- Megan Driscoll
- William Gramlich

108. Discerning the Distribution of Dark Matter via Weak Lensing in Extremely Dense Supercluster Environments

- Sarah Rice
- David Batuski

109. Cyanide Detection in Water Using Infrared Spectroscopy

- Kirsten Dennen
- Nayeem Ibnul
- Carl Tripp

110. Colloidal Interactions to Generate Latex Coated Pigment for Paper Coating Applications

- Pradnya Rao
- Carl Tripp

111. UMCS Lab Help Center

- Jeremy Hutchinson
- Chad Berry
- Nate Gagnon
- Cooper Dahlberg
- Isaac Sparks-Willey
- Penny Rheingans

112. Conjugation of Glycans with Versatile Anthrilimide Base

- Angel Nieves
- Matthew Brichacek

113. Synthesizing Hydrogels from Norbornene-Functionalized Hydroxypropyl Cellulose

- Lauren Andrews
- William Gramlich

Business - Pgs. 63 - 68

201. Sustainability in Clothing Consumption

- Katelynn McFadden
- Erin Percival Carter

202. The Importance of a Checkmark: An Investigation into the Perceptions of Social Media Verification and its Effects on Consumer Trust

- Jazlyn Dumas
- Stefano Tijerina

203. The Effects of Payment For Order Flow on Capital Markets and Investor Money

- Abdullah Karim
- Stephen Jurich

204. The Emergence and Role of the IEX in Market Fragmentation

- Cameron Spicer
- Stephen Jurich

205. Understanding Patterns of Underdevelopment Within the Union: A Dive Into the Competitiveness of Individual States in a Global Marketplace.

- Karim Seifeldin
- Stefano Tijerina

206. Bitcoin Derivative Trading Volume and the Impact of Foreign Government Shock

- Jonathan Libby
- Stephen Jurich

Education - Pgs. 69 - 79

301. Assessing the Effectiveness of a Tool for Classifying and Assessing Student Energy Diagrams in Pre- and Post-COVID-19 Instruction

- Michael Dudley
- Michael Wittmann

302. Youth Relevance in a Science Learning Setting

- Gabrielle Brodek
- Elizabeth Hufnagel

303. The Other Side of the Screen: Understanding the Experience of Adult Learners in Online Learning

- Anne Fensie
- Jennifer Jain
- Teri St. Pierre

- Asli Sezen-Barrie

304. An Analysis of Citizenship Education Efforts in Maine Middle Schools
- Tom Adams
- Rebecca Buchanan

305. Supporting and Exploring the Nature of Student Reasoning: Examining the Impact of Relative Salience on Intervention Effectiveness
- Ryan Moyer
- MacKenzie Stetzer

306. My Life, My Plan
- William Faunce
- Quinn Severs
- Dawsin Blanchard
- Dylan Bulmer
- Terry S. Yoo

307. Arguing Within and Beside a Pyramid: How Can Virtual-Reality be Used to Learn Geometry?
- Camden Bock
- Justin Dimmel

308. One-Week Curriculum for Grades 3-6 on Diversity and Inclusion Employing the Use of Kindness
- Mila Long-Frost
- Lois-Ann Kuntz

309. Augmented Reality Gardens
- Claudio van Dujin
- Jon Ippolito

310. A Recommitment to Peer-to-Peer Contact Through Teacher Supervision and Support
- Jason Kash
- Kelsey Stoyanova
- Ian Mette

311. Middle School Science Teachers' Experiences of Vulnerability in a Professional Learning Community
- Eliza Jacobs

- Elizabeth Hufnagel

312. Social Justice Through Social Media

- Mikayla Palmer
- Moriah Weitman
- Rebecca Buchanan

Allied Health - Pgs. 80 - 102

401. Changes in School Nurse Perception of Adopting Bleeding Control Curriculum

- Megan Gallant
- Patricia Poirier

402. Screening Women for Late-Life Depression: The Primary Care Family Nurse Practitioner's Role

- Elissa Tremblay
- Eileen Owen-Williams

403. Does Providing Education Reduce Vaccine Hesitancy?

- Stephanie Massey
- Kyle D. Massey
- Patricia Poirier

404. Developing a Level II Neonatal Intensive Care Unit (NICU) Nurse Orientation

- Erin Voisine
- Patricia Poirier

405. An Assessment of Stress in Undergraduate Nursing Students

- Amy Barnes
- Patricia Poirier

406. Implementation of a S.K.I.N. Response Team as a Multidisciplinary Approach to Pressure Injury Care and Prevention

- Shannon Jagger
- Patricia Poirier

407. In Women of Childbearing Age with Cervical Ectopy (Cervical Erosion), How Does Cryotherapy Compared to Vaccination Affect the Incidence of Human Papillomavirus (HPV)?

- Elena Kolesnikova
- Emilienne Soucy
- Kaylin Le
- Madison Bibbo
- Valerie Herbert

408. Statin Use and Dementia Incidence

- Mariana Day
- Eva Quirion

409. Communication with Patients on End of Life

- Danielle Fabian
- Patricia Poirier

410. The Effects of COVID-19 in the Treatment of Opioid Use Disorder

- Claire Collins
- Ashley Oullette
- Abigail Danforth
- Jane Stevens
- Valerie Herbert

411. Effect of Remote Mental Health Services on Anxiety and Depression Rates During the COVID-19 Pandemic

- Stephanie Nichols
- Jennifer Turner
- Miranda McKim
- Valerie Herbert

412. The Effects of Nurse Patient Ratios on Geriatric Patient Outcomes

- Deanna Kolenovic
- Emma Moulton
- Taylor Jackson
- Victoria Shepardson
- Valerie Herbert

413. A Quality Improvement Approach to Reducing Hospital Readmission Rates in Heart Failure Patients

- Anna Cressey
- Natalia Budri
- Eliza Palow
- Reilley Joyce
- Valerie Herbert

414. The Effect of Group Activities on Cognitive Decline in Those Diagnosed with Dementia

- Hannah Nadeau
- Gabbi Kaczynski
- Katie Swanson
- Megan Sobiech
- Valerie Herbert

415. Benefits of Female External Urinary Catheters

- Mary Chamberlin
- Andrea Bresnahan
- James Cramer
- Sierra Harmon
- Valerie Herbert

416. Effects of Volunteering on the Health of Older Adults in a Caregiving Role

- Rachel Coleman
- Jennifer Crittenden

417. Frontline Nursing Leadership Program

- Sarah Hanscome
- Lori Fiandaca
- Patricia Poirier

418. Program Profile Project: How RSVPs Support Older Adult Volunteers Who are Working and Caregiving

- Abbie Hartford
- Jennifer Crittenden

419. Healing the Cycle of Intergenerational Trauma: The Family Nurse Practitioner's Role

- Jessica Alicea-Santiago
- Patricia Poirier

420. Rural Disparities for the Elderly

- Dana Lyon
- Eva Quirion

421. Making Aging in Place Possible for Maine Seniors

- Briann Andrews
- Kelley Strout

422. Hypertension in Rural Haiti Screening, Treatment, and Management

- Joseph Morse
- Eileen Owen-Williams

423. Early Home Visiting Programs: A Key Component of Maternal and Infant Health in Maine

- Rebecca Bolduc
- Patricia Poirier

424. Education and Nursing Interventions of the Spinal for Injury Patient

- Amanda Cowan
- Patricia Poirier

425. Motivations and Experiences of Older Adult Volunteers: An Exploration of a Telehealth Simulation Experience

- Kayla Thompson
- Jennifer Crittenden

426. **Older Adult Nutrition Innovation Pilot: Partner Interviews**

- Jennifer Jain
- David Wihry

427. Operationalizing Person-centered Care in Long Term Care Settings: Initial Literature Review Findings

- Rocky Coastlines
- Jennifer Crittenden

Engineering and Information Sciences - Pgs. 103 - 144

501. Production of Renewable Fuels from Biomass-Derived TDO Oil

- Matthew Kline
- Sampath A. Karunarathne
- M. Clayton Wheeler

502. Professorly

- John Baker
- Ryan Matthew LaMarche
- Jon Ippolito

503. Thermoplastics 3D Printing Using Fused Deposition Modeling on Fabrics

- Maxwell Blais
- Scott Tomlinson
- Bashir Khoda

504. Electrical Power System for CubeSats

- Joseph Patton
- Ali Abedi

505. Joining Methods for Continuous Fiber Reinforced Thermoplastic Composites in Structural Applications

- Andrew Moran
- Roberto Lopez-Anido

506. Magnetorquer Design for Small Satellites

- Travis Russell
- Ashanthi Maxworth
- Ali Abedi

507. Operation and Preliminary Energy Balance of a Portable Kelp Dryer in Maine

- Tuqa Al-Asadi
- G. Peter van Walsum

508. Search and Rescue Sled Suite

- Jesse Bosdell
- Liza White
- Caroline Bray
- David Neivandt

509. Investigation of Bioaerosol Catch-and-Release Dynamics via Liquid Net Filtration

- Dan Regan
- Junie Fong
- Justin Hardcastle
- Caitlin Howell

510. Finite Element Analysis of Glucose Diffusivity in Peripheral Nerve Conduits

- Nicklaus Carter
- David Neivandt

511. Dynamic Visualization of Past and Future Forest Change Within the Maine Forest Ecosystem Status and Trends Web Application

- Scott Audet
- Eric Schessler
- Ethan Esber
- Devin Merrow
- Dominic Pacelli
- Kasey Legaard

512. Precision Actuator for Small Scale Robotics

- Patrick Murphy
- Bashir Khoda

513. High Shear, High Residence Time Drying of Cellulose Nanofibrils

- Brandon Dixon
- Amos Cline
- David Neivandt

514. Do Virtual Flavors Influence Liking and Emotions?

- Meetha Nesam James
- Nimesha Ranasinghe

515. Techno-Economics and Life Cycle Analysis of a Biofuel Blend-stock Process

- Aysan Najd Mazhar
- Thomas Schwartz
- Sampath Reddy Gunukula
- M. Clayton Wheeler

516. A Birefringence Semantic Segmentation of Muscular dystrophy in Zebrafish Using Deep Neural Networks

- Ahmed Almaghasilah
- Clarissa Henry

517. Tuning CNF Fibril Orientation for Tissue Integration Applications

- Josh Hamilton
- Sahar Roozbahani
- Omar Alsamsam
- Michael Mason
- Karissa Tilbury

518. Design and Manufacturing of Printing Head for Aligning Short Fibers

- Miao Hu
- Akhter Zia
- Yingchao Yang

519. Characterization of electrically-conductive filament for FDM 3D-Printing

- Mackenzie Ladd
- Brett Ellis

520. Abstract Moved to Another Category

521. Flight Computer Design for Cube Satellites

- Steele Muchemore-Allen
- Ali Abedi

522. Relay-Assisted Wireless Energy Transfer Scheduling with Dual Data-Energy Channel Models

- Sonia Naderi
- Ali Abedi

523. Bioinspired Liquid-Infused Membranes Reduce Biofouing

- Justin Hardcastle
- Daniel Regan
- Junie Fong
- Jessica Schiffman
- Rushabh Shah
- Caitlin Howell

524. Solid Particles Transfer by Dipping From Heterogeneous Mixture

- S M Abu Naser Shovon
- Bashir Khoda

525. Developing Software for Aerial Imagery Handling and AI Analysis Management

- Devin Christianson
- Nick Kania
- Jacob Morin
- Alex Feren
- Kyle Walker
- Cynthia Loftin

526. MLA Survey Analyzer

- Benjamin Patashnik
- Alex Gay
- Mark Sullivan
- Jeremy Thiboutot
- Erin Vinson

527. Electrical Impedance Spectroscopy Based Food Recognition to Facilitate Food Journaling

- Chamath Lochana Amarasinghe Hiti Harmillage
- Nimesha Ranasinghe

528. Nanoparticles as Local Reporters in Biological Systems: Modeling Signal and Understanding Limitations

- Jeremy Grant
- Aimee Co
- Michael Mason

529. A Smart Wheelchair Cushion to Reduce the Incidence of Pressure Sores in Low-Mobility Populations

- David Flewelling
- Malak Helal
- Michael Gray
- Michael Mason

530. Binary Maze Game

- Ethan Mason
- Jeffrey Edrington

- Andrew Sheaff

531. Smart Tourniquet: A New Approach to Existing Technology

- Darren Hanscom
- Emily LeClair
- Tian Morrison
- Chris Toothaker
- Lisa Weeks
- Michael Mason

532. What Personal Information is Your App Collecting?

- Vijayanta Jain
- Sepideh Ghanavati

533. Investigating 3D-Printability of a Maine-Based Bio-Ink

- Jordyn Judkins
- Bashir Khoda

534. A Custom Centrifuge Tube and for the Collection of Microliter Volume from a Microneedle Skin Patch

- Cole Perry
- Caleb Berry
- Scott Collins
- Rosemary Smith

535. Compact VO2 Max Testing Device

- Zane Kwiatkowsky
- Quinn Ferguson
- Shanna Scribner
- Nathan Loranger
- Michael Mason

536. Solar Power System for Forest Bed Sensing

- Victoria Nicholas
- Ali Abedi

537. Fabrication of Metallic Organic Frameworks on Carbon for Water Treatment

- Aidan McGlone
- Yingchao Yang

538. Protecting Privacy in the Heterogeneous Internet of Things

- Sanonda Gupta
- Aubree Nygaard
- Stephen Kaplan
- Vijayanta Jain
- Sepideh Ghanavati

539. Wavelet-Based Automatic Pectoral Muscle Segmentation from Mammograms

- Basel White
- Andre Khalil

540. Cellulose Nanofibrils Aerogels and Iron Oxide-based Nanoparticles for Arsenic Removal From Drinking Water

- Md Musfiqur Rahman
- Islam Hafez

541. Development and Optimization of Droplet-Forming Dip Coating Process

- Aimee Co
- Karissa Tilbury
- Bashir Khoda

542. Developing the SMART Cane for the Visually Impaired

- Jordan Miner
- Kora Kukk
- Natalie St. Louis
- Jennifer Triana
- Caitlin Howell

543. Concentrating Viruses From Sewage for SARS-CoV-2 Monitoring

- Kettie Rose Cormier
- Audrie French
- Harrison Cyr
- Jean MacRae

544. Wireless Soil Moisture Sensor Network

- Thayer Whitney
- Tori Nichols
- Sonia Naderi
- Ali Abedi

545. Imaging Zebrafish with Duchenne Muscular Dystrophy using Second-Harmonic Generation to Evaluate Myosin Structure

- Jordan Miner
- Andre Khalil
- Clarissa Henry
- Elisabeth Kilroy
- Karissa Tilbury

546. Abstract Withdrawn

547. Strain Sensor for Harsh Environments

- David Leff
- Mauricio Pereira da Cunha

548. Compact VHF and UHF Antennas for Integration With SAW Devices in Harsh Environment

- Sri Lekha Srimat Kilambi
- Mauricio Pereira Da Cunha

549. Particles Sorting From Poly-disperse Mixture Using Dip-coating

- Md Ibrahim Khalil
- Bashir Khoda

550. Lighter Than Air Technology for Remote Sensing Applications

- Hamza Azzam
- Alex Friess

551. Mechanical Performance of 3D Printed Lattice Structures: Assembled Vs Direct Print

- Adeeb Alam
- Keith Berube
- Bashir Khoda

552. Contact Tracing Via Bluetooth Beacons

- Jacob Mealey
- Michael Scott

553. Sailing Velocity Prediction Program

- Andrew Arter
- Alex Freiss

554. Exploration of Olfactory Interventions as a Synergistic Emotional and Cognitive Recovery Technique

- Leah Parrish
- Nimesh Ranasinghe

555. Durability Evaluation of Carbon Fiber Composite Strands in Highway Bridges

- Braedon Kohler
- Roberto Lopez-Anido
- Andrew Goupee
- Keith Berube

556. Slimming Neural Networks using Adaptive Connectivity Scores

- Dawsin Blanchard
- Madan Ravi Ganesh
- Jason J. Corso
- Salimeh Yasaei Sekeh

Arts - Pgs. 145 - 154

601. Postal Project

- Rochelle Lawrence
- Susan Lynn Smith

602. Shadow Box Theater

- Drake Perkins
- Jon Ippolito

603. Pinus longaeva: Discovering Form and Value through Ancient Bristlecone Pine Trees

- Delaney Burns
- Andy Mauery

604. Curious the Cat and the COVID-19 Quarantine

- Jacob Stutzman
- Susan Lynn Smith

605. MoodTracker: The Journal App that Visualizes Your Mood

- Jared Steinbrecher

- Jon Ippolito

606. Four Sacred Medicines
- Christiana Becker
- Susan Lynn Smith

607. The Journey of Perseverance - A Rover's Perspective, from Inception to Launch (Phase 1 of A Large-Scale, Multiple-Phase, Socially-Engaged Art & Science Installation Series)
- Anna Soule
- Shawn Laatsch

608. Whites Only
- Anna Soule
- Derek Smith
- Stanley Levitsky
- Owen Smith

609. UMaine AR Campus Touring UniAR
- Thanisorn Jarujinda
- Jon Ippolito

610. MicroMacro Space Connected
- Thomas Griffith
- Susan Lynn Smith

611. Illustrations Challenging Tropes of LGBT+ Individuals
- Spencer Atkinson
- Lois-Ann Kuntz

612. Presence, in Time and Space, Subject to Changes and Actions of Others
- Katarina Hoeger
- Susan Lynn Smith

613. Inside Art
- Owen Savage
- Jon Ippolito

614. Ease Meditations
- Caitlyn Sharples

- Jon Ippolito

Social Sciences and Humanities - Pgs. 155 - 187

701. Are Adverse Childhood Experiences Associated with Worse Cognitive Function in Older Adults?

- Amy Halpin
- Angelica Boeve
- Sahvannah Michaud
- Michael Fagan
- Rebecca MacAulay

702. Effects of the Transportation and Climate Initiative Program on the Maine Economy: An Analysis of Cap-and-Invest and its Heterogeneous Impacts on Rural and Urban Households

- William Somes
- Jonathan Rubin

703. Wabanaki Tools of Diplomacy and LD 291: Storying Protocols as Political Will

- Nolan Altvater
- Bridie Mcgreavy
- Darren Ranco

704. Understanding Current Public Sentiment Towards Biologically Engineered Food Products

- Kathleen Tims
- Ek Han Tan

705. Preliminary Effects of Brief RO DBT Intervention on Dyadic Social Interaction and Overcontrol in Young Adults

- Jennifer Hugg
- Cynthia Erdley

706. Systemic Language Discrimination in the United States

- Stephanie Tillotson
- Zachary Ludington

707. How Alumnae of a Feminist Organization Perceive Their Involvement as Related to Their Academic Self-concept During Middle-High School

- Miranda Snyder
- Susan K. Gardner

708. Assessing the Relationship Between Adverse Childhood Experiences, Working Memory, and Perceived Stress in Older Adults

- Sahvannah Michaud
- Amy Haplin
- Angelica Boeve
- Rebecca MacAulay

709. How Androcentric are University Forestry Program Cultures? A Cross-Institutional Qualitative Case Study of Undergraduate Forestry Student Experiences

- Emily Roth
- Jessica Leahy
- Mindy Crandall
- Laura Kenefic

710. Abstract Moved to Another Category

711. Abstract Moved to Another Category

712. Role of Chronic and Acute Stress in the Development of Obesity Between Members of Different of Socioeconomic Groups

- Isabelle Stevens
- Shelby Helwig
- Shannon McCoy

713. Moved to Late Breaking Abstracts

714. The Stigmatization of Formerly Incarcerated Citizens

- Amy Frankel
- Sydney Massa
- Marina Slover
- Elizabeth Depoy

715. The Impact of COVID-19 and Telehealth Usage for Recovery Program Participants at Seaport Community Health Center

- Sarah Juster

- Colleen Keegan
- Kate Pontius
- Priscilla Domingo
- Samuel Roy
- Elizabeth Armstrong

716. The Effects of Different Curricula on Perceptions of the Science-Religion Relationship

- Darby Casey
- Sally B. Barker
- Jordan P. LaBouff

717. Cardiovascular Effects on Cognition in Young Adults: The Relationship Between Exercise, Physical Activity, and Processing Speed

- Taylor McMillan
- Lindsey Lagerstrom
- Jennifer Thompson
- Fayeza Ahmed

718. Community Support for Low-Income Elementary School Students with a Winter Gear Drive under COVID 19 Constraints

- Paige Wentworth
- Lois-Ann Kuntz

719. Moved to Late Breaking Abstracts

720. Sleep Health Domains Differentially Impact Aspects of Executive Function in Older Adults

- Angelica Boeve
- Amy Halpin
- Michael Fagan
- Sahvannah Michaud
- Rebecca MacAulay

721. Abstract Moved to Another Category

722. Parent-Adolescent Relationships of International Boarding High-School Students

- Kittiya Reeves
- Jessie Anderson
- Kristen Brewer
- Daniel Puhlman

723. A Lens Model Approach to the Nonverbal Expression of Fatigue

- Morgan Stosic
- Mollie Ruben

724. Moved to Late Breaking Abstracts

725. Joe Polis and the Search for the Northern Highlands

- Jacob McCarthy
- Kreg Ettenger

726. Communicating Carcharodon carcharias Forecasting and Conservation Using eDNA Analysis From the Gulf of Maine

- Bradlyn McEttrick
- Jessica Reilly-Moman

727. Maine's Rural Youth: Exploring Migration Plans through Place and Community Attachment Theories

- Zachary Davis
- Kathleen Bell
- Mindy Crandall
- Jessica Leahy

728. The Impact of Mental Health Stigma on Hireability

- Cassidy McCusker
- Mollie Ruben

729. Honors and Eating Concerns

- Ailin Liebler-Bendix
- Jamie Ginguere
- Ethan Lowell
- Bailey Lewis
- Jeffrey Hecker

730. Monitoring Uncertainty

- Rose Deng
- Shawn Ell

731. The Effects of COVID-19 on Hospitality and Building Supply Sales in Maine

- Yelshaday Gebreselassie
- Todd Gabe

- Kathleen P. Bell

732. Moose (Alces alces) in the Dawnland: Parasitic Pressures, Fragmented Management, and Sustaining Culturally Important Relationships with the Wabanaki Confederacy

- Alaina Woods
- Jason Brough
- Elizabeth Leclerc
- Steven Golieb
- Katie Glover

733. Pathfinder

- Tyler D'Ambrosio
- Jon Ippolito

734. College Students Combat Period Poverty: Free Access to Menstruation Products

- Teresa Gallanti
- Lois-Ann Kuntz

735. Abstract Moved to Another Category

736. Assessing the Role of Traditional Ecological Knowledge in Sustainable Food Systems

- Matthew James
- Douglas Hasson
- Alex Bromley
- Elise Gudde
- Gregory Zaro

737. The Pandemic and its Positive Impact: A Content Analysis of Media Coverage Bre Cummings, Tara Foley, Alexandra Karter & MacKenzie Nixon

- Breann Cummings
- Tara Foley
- Alexandra Karter
- Mackenzie Nixon
- Sandra L. Caron

738. S.S. Media: Giving Researchers access to Social Media

- Ryan Handlon
- Colleen DeMaris
- Griffin Fluet
- Abdullah Karim

- James West
- Terry Yoo

739. Increasing Childhood Educational Attainment Through Family Resource Connections and Advocacy

- Ambrosia Ross
- Lois-Ann Kuntz

740. Supporting US Military Veterans Transitioning to Civilian Life: Exploring a New Model

- Carol Lane
- Lois-Ann Kuntz

741. Cyber Victimization and Internalizing Distress: Avoidant Problem-Solving Style Moderates Depressive, but not Social Anxiety Symptoms

- Allison Marcellino
- Jade Perry
- Michelle Buffie
- Douglas Nangle

742. What It Was And What I Know: Attempts at Family History

- Katherine Reardon
- Gregory Howard

743. Moved to Late Breaking Abstracts

744. Talking with Children About COVID-19: A Content Analysis of National Media Coverage

- Colby Kreider
- Natalie Coleman
- Isabel Larsen
- Gabriella Miller
- Sandra Caron

745. Investigating Emptiness in Buddhism and Daoism

- Aubree Nygaard
- Hao Hong

746. Mediation of the Religion Prejudice Link

- Aaron Dustin

- Sally B. Barker
- Jordan P. LaBouff

Natural Sciences - Pgs. 188 - 241

801. Examining Remote Sensing Land Surface Temperatures in the St. Elias Range

- Ingalise Kindstedt
- Kristin Schild
- Dominic Winski
- Dorothy Hall
- Luke Copland
- Seth Campbell
- Karl Kreutz

802. Mulch as a Crop Management Tool in Wild Blueberry

- Rebecca Gumbrewicz
- Lily Calderwood

803. PFAs-free Wood-based Food Serving Plates With Excellent Oil and Grease Resistance

- Rakibul Hossain
- Mehdi Tajvidi

804. The Effects of Timber Harvesting on Ixodes Scapularis Densities and Tick-borne Pathogen Transmission in Maine

- Stephanie Hurd
- Laura Kenefic
- Jessica Leahy
- Andrew Richley
- Carly Sponarski
- Allison Gardner

805. Antioxidant, Antimicrobial and Hydrophobic CNF Films as an Active Packaging Material

- SuriyaPrakaash Lakshmi Balasubramaniam
- Denise Skonberg
- Caitlin Howell
- Mehdi Tajvidi

806. A Comparison on the Contributions of Management Practices Regarding Intestinal Parasites in Companion and Production Pigs

- Kianna Dean
- Anne Lichtenwalner

807. Do Small Female Lobsters Produce Lower Quality Eggs?

- Alexander Ascher
- Richard Wahle
- David Fields
- Maura Niemisto

808. Evaluating Sustainability Metrics For River Herring Populations During Restoration

- Margaret Campbell
- Justin Stevens

809. Ideal Conditions for Cryptosporidium Attachment and Infection

- Emily Pierce
- Sarah Hosler
- Sue Ishaq

810. Human Facial Recognition in Holstein Heifers

- Kendra Huth
- David Marcinkowski

811. Predicting Range Shifts for the Virginia Opossum Based on Climate Change

- Sara Griffin
- Danielle Levesque

812. Assessment of Potential Measures of Harbor Seal Pup Rehabilitation Success at Admit

- Shannon Brown
- Kristina Cammen

813. Investigating Changes in the Subcutaneous White Adipose Tissue (scWAT) Proteome in Response to Cold Exposure

- Dylan Taplin
- Cory Johnson
- Kristy Townsend

814. Biophysical and Social Drivers of Tick Exposure Risk Due to Climate Change in Maine

- Brittany Schappach
- Allison Gardner

815. Estimating the Cost and Break-even Point of a Small-scale Timber Harvesting Operation

- Ashish Alex
- Anil Raj Kizha

816. Breaking Down "Harassment" to Characterize Trends in Human Interaction Cases in Maine's Pinnipeds

- Emma Newcomb
- Kristina Cammen

817. Environmental and Social Factors of Mosquito Abundance and Species Distribution Across a Land-Use Gradient

- Megan Schierer
- Allison Gardner

818. Assessing Animal Research During the Covid 19 Pandemic: A Literature Review

- Aidan Redding
- Anne Lichtenwalner

819. The Effects of COVID-19 on Large Animal Veterinary Practices in Maine

- Isabelle Fernald
- Sue Ishaq

820. Genetic Analysis of Yellowtail (Seriola lalandi) for Aquaculture in Maine

- Sydney Avena
- Kristina Cammen

821. Aquaculture Site Selection Through Dynamic Energy Budget Models Coupled With High-resolution Satellite Products

- Thomas Kiffney
- Gabe Hesketh
- Binbin Jiang
- Emmanuel Boss
- Damian Brady

822. Implications of Social Media in Nursing

- Courtney Benson
- Trevor Barry
- Candace Doughty
- Kristina Glynn
- Valerie Herbert

823. Assessing Gastropods as Parasite Vectors: Problem and Prevention on Maine Farms

- Rachel White
- Tuuli Overturf
- Laura Freudenberger
- Anne Lichtenwalner

824. Post-Surgical Pain Management : Non-Pharmacological vs. Pharmacological

- Kendall Brown
- Elyse Good
- Samantha Dauphinee
- Kelly Goodall
- Valerie Herbert

825. Detection of Stable Subgroups Among Dynamic Microbial Communities

- Steven Allers
- Benjamin King

826. Detection and Survival of Listeria Monocytogenes on Seaweed (Sugar Kelp) During Storage

- Samuel Akomea-Frempong
- Denise I. Skonberg
- Jennifer Perry

827. Physicochemical Analysis and Effects of Processing on North Atlantic Squid Species

- Caitlin Hillery
- Brianna Hughes
- Denise Skonberg

828. Streamflow Change and Potential Impact on Australian Indigenous Water Values

- Rachel Coleman
- Shaleen Jain

829. Using Different Aerial Imagery Platforms to Assess Marine Debris and its Relationship to Island-Nesting Seabirds

- Lauren Maher
- Meredith Lewis
- Logan Kline
- Cynthia Loftin
- Aly McKnight

830. Dulse Nursery

- Kiera Luu
- Luz Kogson
- Tim Bowden

831. Using Local Ecological Knowledge to Describe Estuarine Use Patterns and Inform Community Management of Shellfish

- Sara Swett
- Sarah Risley
- Melissa Britsch
- Heather Leslie

832. Transcriptomic Variation Underlying Pollution Resistance in Fish

- Anna Briley
- Akila Harishchandra
- Richard T. Di Giulio
- Casey Lindberg
- Nishad Jayasandura

833. Social-Ecological Mapping of "Sweet Spots" for Beekeeping and Maple Syrup Producers

- Joseph Romick
- Jessica Leahy
- Kathleen Bell
- Sara Velardi

834. The Relationship Between Kidney Function and Cognitive Function in Type 2 Diabetics

- Erika Pacheco
- Fayeza Ahmed

835. A Facile Thermal Compression Based Technique to Dry Cellulose Nanofiber Film for Renewable and Biodegradable Packaging Application

- Md Ikramul Hasan
- Jinwu Wang
- Mehdi Tajvidi

836. Optimization of Pure American Chestnut Seedling Growth in the Greenhouse

- Kat Klebon
- Ek Han Tan

837. Ilulissat Icefjord Iceberg Distribution Relation to Tributary Glacier Behavior

- Sydney Baratta
- Kristin Schild

838. Evaluation of the Microbial and Chemical Variation of the Kombucha Beverage with Repeated Brewing and Prolonged Refrigerated Storage.

- Adwoa Dankwa
- L. Brian Perkins
- Jennifer Perry

839. Glycan Mediated Cellular Differentiation in Cellulose Based Hydrogels

- Ayan Dutta
- William Gramlich

840. Preliminary Quality Assessment of Green Crab (Carcinus Maenas) Roe

- Holly Leung
- Jennifer Perry
- Denise Skonberg

841. Using Poultry as a Method of Control for Ruminant Pathogen Parelaphostrongylus tenuis

- Tuuli Overturf
- Anne Lichtenwalner

842. Impact of Newborn Skin to Skin on Bonding, Breastfeeding and Thermoregulation

- Summer Egbert
- Catherine Christiansen
- Meghan Mcdonald
- Emily Lund
- Valerie Herbert

843. Optimization of Carcinus maenas Fermentation

- Delaney Greiner
- Denise Skonberg
- Brian Perkins
- Jennifer Perry

844. Fungal Communities of Ancient and Contemporary Antarctic Sponges

- Nicole Ritchey
- Laurie Connell

845. Interventions to Decrease Chronic Obstructive Pulmonary Disorder Exacerbations

- Alyssa Karlins
- Kristen Veilleux
- Nicole Despres
- Sophie Russell
- Valerie Herbert

846. Assessing Long Range Aerosol Transport in the North Pacific on Seasonal to Millennial Time Scales

- Hanna Brooks
- Karl Kreutz

847. Public Perception of Gray Seals in New England: A Media Content Analysis

- Shannon Smith
- Gabrianne McIntosh
- Christina McCosker
- Kristina Cammen

848. Physiological Comparison of Highbush and Lowbush Blueberries and Their Response to Chemical Application and Drought Stress

- Emma Gibbons
- Yongjiang Zhang

849. Effects of Biochar-Compost Mix on Wild Blueberry Soil Properties for Mitigating Crop Drought Stress

- Zachary Maynor
- Rafa Tasnim
- Yongjiang Zhang

850. The Ecology of the Blacklegged Tick in an Emergent Area for Tickborne Disease

- Griffin Dill
- Allison Gardner

851. Assessing the Utility of Dynamic Particle Imaging in South Pole Ice Core Dust Analysis

- Aaron Chesler
- Bess Koffman
- Karl Kreutz
- Dominic Winski
- David Ferris
- Zayta Thundercloud
- Joseph Mahon
- Jihong-Cole Dai
- Mark Wells
- Michael Handley
- Aaron Putnam
- Katherine Anderson
- Natalie Harmon

852. Uptake and Redistribution of Bacillus cereus Spores in Kombucha Systems

- Alexandria Bromley
- Jennifer Perry

853. Determining How Prophage Interaction Impacts the Expression of the Transcription Factor, whiB7

- Sarah McCallister
- Jaycee Cushman
- Sally Dixon
- Keith Hutchison

854. Essential Factors for Mycelium-lignocellulosic Biocomposites Production

- Wenjing Sun
- Mehdi Tajvidi

855. The Suitability of Macroalgal Species for Integrate Multi-Trophic Aquaculture in Land-Based and Ocean-Based Aquaculture Farms: A Literature Review

- Hannah Koehler
- Susan Brawley

856. Turn the Tap: Integrated Research to Support Sustainable Irrigation Practices on Northeast Vegetable Farms

- Haley Jean
- Rachel Schattman

857. Forward Genomics of a Complex Trait: Mammalian Basal Metabolic Rate

- Caleigh Charlebois
- Diane Genereux
- Joy-El Barbour Talbot
- Ana Breit
- Danielle Levesque

858. Impact of Salting and Brining on Physicochemical and Microbial Quality of Sugar Kelp

- Richa Arya
- Jennifer Perry

859. Multifunctional Cellulose Nanocrystal Films prepared with Trivalent Metal Ions for Food Packaging

- Cong Chen
- Douglas Gardner

860. Phenolic Extracts from Wild Blueberries Promote Vascularization Associated with Wound Healing

- Natalie VandenAkker
- Tolu Adekeye
- James Weber
- Dorothy Klimis-Zacas

861. Assessing Spatial and Temporal Variability in Zooplankton Biomass in the Gulf of Maine

- Emma Dullaert
- Jeffrey Runge
- Lee Karp-Boss

862. Influence of Energy Mix and Location in Whole Building Life Cycle Assessment

- Marilia Hellmeister
- Stephen M. Shaler

863. Brewers' Spent Grain (BSG) Fermentation.

- Adoum Fadaya Arabi
- Denise Skonberg

864. Differences in Management Action Acceptability for Deer in Maine
- Anna Fitch
- Carly Sponarski

865. Investigation of CRISPR-Cas9 Editing on an Arabidopsis thaliana Minichromosome
- Benjamin Moore
- Ek Han Tan

866. Moved to Late Breaking Abstracts

867. Quantification of Variance and Drought Resistance of Maine Wild and high bush Blueberries
- Aldous Hofmann
- Pratima Pahadi
- YongJiang Zhang

868. Production of Wood Flour from Secondary Processing Mill Residues in Maine and its Utilization
- Geeta Pokhrel
- Douglas Gardner

Interdisciplinary Research - Pgs. 242 - 246

901. Assessing Climate Change Impacts on Food Insecurity: Millinocket Case Study
- Sean Driscoll
- Jared Entwistle
- Anna Olsen
- Carly Frank
- Katherine Glover

902. Government Deforestation Practices and Indigenous Rights
- Sarah Dennison
- Beth Jackson
- Casey Olechnowicz
- Christophe Mbuye

- Katherine Glover

903. One-step Hydrothermal Synthesis With in Situ Milling of Biologically Relevant Hydroxyapatite

- Sahar Roozbahani
- Mitchell Chesleya
- Raymond Kennard
- Michael Mason

904. The Use of Augmented Reality to Monitor Coastal Erosion

- Nicholas Sherman
- Elijah Story
- Michael Scott

905. Understanding Indigenous Connections to Sand in Maine Through Place Names

- Madeleine Landrum
- Lance Stasinski
- Hazel Cashman
- Haley Albano
- Katherine Glover

906. Moved to Late Breaking Abstracts

Biomedical Sciences - Pgs. 247 - 321

1001. The Role of McProf's ESX-like TA Cassette in M. chelonae Antibiotic Resistance

- Anna Schumann
- Jaycee Cushman
- Sarah McCallister
- Keith Hutchison
- Sally Molloy

1002. Role of the Accessory Domain on CpsA Function and Capsule Production in Group B Streptococcus

- Gina DiFederico
- Melody Neely

1003. The COVID-19 Public Health Response and Alcohol Abuse: A Comprehensive Analysis

- Anthony Posuniak
- Deborah Saber

1004. Repurposed Therapeutics for Treatment of JC Polyomavirus Infection

- Avery Bond
- Mason Crocker
- Michael Wilczek
- Melissa Maginnis

1005. AAV9-Ighmbp2 Gene Therapy Significantly Improves Motor Performance in Severe SMARD1-like Mouse Model, nmd-em3, and CMT2S Mouse Model, nmd-em5

- Sarah Holbrook
- Amy Hicks
- Greg Cox

1006. Characterizing the Role of Prophage on whiB7 Expression and Antibiotic Resistance in Mycobacterium chelonae

- Jaycee Cushman
- Emma Freeman
- Sarah McCallister
- Anna Schumann
- Keith Hutchison
- Sally Molloy

1007. Discovering Virulence Factors of Candida albicans that Affect Host Immune Responses

- Emma Bragdon
- Bailey Blair
- Nnamdi Baker
- Robert Wheeler

1008. Understanding the Role of Perivascular Adipose Tissue Differentiation in Cardiovascular Disease

- Caitlin Stieber
- Joshua Boucher
- Lucy Liaw

1009. Understanding the Mechanism of Cancer Treatment Induced Ovarian Toxicity

- Monique Mills
- Chihiro Emori
- Parveen Kumar
- Zachary Boucher
- Ewelina Bolcun-Filas

1010. Characterization of Dual Specificity Phosphatase 1 (DUSP1) Activity and the Immune Response during JC Polyomavirus Infection in Primary Human Astrocytes

- Aiden Pike
- Michael Wilczek
- Melissa Maginnis

1011. Identification of Potential Antiviral Drug Targets in JC Polyomavirus Infection

- Nicholas Leclerc
- Avery Bond
- Mason Crocker
- Melissa Maginnis

1012. Temporal Dynamics of Viral Load and False Negative Rate Influence the Levels of Testing Necessary to Combat COVID-19 Spread

- Katherine Jarvis
- Joshua Kelley

1013. Defining the Role of G-Protein Receptor Kinase 2 in JC Polyomavirus Entry

- Paige Giffault
- Colleen Mayberry
- Kashif Mehmood
- Melissa Maginnis

1014. Multiscale Image Colocalization

- Aidan Greenlee
- Jeremy Juybari
- Andre Khalil

1015. Spatial Frequency Domain Imaging Applications in Polyneuropathy

- Christian Crane
- Karissa Tilbury

1016. Effects of Oral-care Antimicrobial Cetylpyridinium Chloride on Tyrosine Phosphorylation: A Potential Mechanism for Mast Cell Inhibition Assessed via In-Cell Western

- Jessica Bruno
- Bailey West
- Julie Gosse

1017. Genetic Sequencing of CYP2C19 and CFTR Mutations and Their Application to Personalized Medicine

- Rebecca Collins
- Aiden Pike
- Claire Bourett
- Claire Nowak
- Michaela Gervais
- Paige Giffault
- Denry Sato
- Bruce Stanton
- Benjamin King

1018. Evaluation of the Changes of Nerve Function Following a Sciatic Nerve Crush in CD137 Ligand Knockout Mice Using Electromyography Measures

- Rebecca Peters
- Ling Cao

1019. Macrophage Response to Bone Marrow Adipocyte Expansion in C57BL/6J Mice

- Samantha Costa
- Gisela Pachón-Peña
- Clifford Rosen

1020. Antioxidant Effects of Winterberry Leaf Extract

- Cara McKinnon
- Brendan Moline
- Weaam Al Hallaf
- Brian Perkins
- Sam W. Caito
- Jennifer Newell-Caito

1021. Role of Non-Coding RNAs in Adaptation to Environmental Stressors Through the Study of Natural Populations

- Kayla Barton

- Adrienne Kovach
- Brian Olsen
- Benjamin King

1022. Investigation of the Extracellular Matrix in DMD Zebrafish Under Inactive and Endurance Exercise Treatments

- Kodey Silknitter
- Elisabeth Kilroy
- Benjamin King
- Clarissa Henry

1023. Investigating the Presence of Putative RNA Thermometer-like Structures in the Zebrafish (Danio rerio) Mitochondrial Genome.

- Abigail Muscat
- Nishad Jayasundara

1024. Description of A Novel CRISPR Vertebrate Model of Dolichyl-Phosphate Mannosyltransferase 3-Associated Secondary Dystroglycanopathies

- Claire Schaffer
- Clarissa Henry

1025. Investigating the Cell-Type Dependent Host Signaling Mechanisms of JC Polyomavirus

- Remi Geohegan
- Michael Wilczek
- Melissa Maginnis

1026. Surface Acoustic Waves for Manipulation of Fluid and Biomolecules

- Joel Tewksbury
- Caitlin Howell
- Mauricio Pereira da Cunha

1027. Characterizing the Role of IRS1/2 in Osteocyte Differentiation and Function in Bone Development

- Vivin Karthik
- Victoria victoria van Berlo
- Li Tian
- Jennifer Daruszka
- Victoria DeMambro
- Anyonya Guntur

1028. Design of Theoretical Modeling to Support a Regenerative Radiation Shield for Deep-Space Exploration

- Benjamin Chasse
- Ainslie Allen
- Damon Williams
- Riley Drummond
- Caitlin Howell

1029. Caloric Restriction and Fasting Diets have Negligible, or Potentially Damaging, Effects on Cognition in Diversity Outbred Mice

- Andrew Ouellette
- Niran Hadad
- Andrew Deighan
- Kristen O'Connell
- Adam Freund
- Gary Churchill
- Catherine Kaczorowski

1030. Rapid Local Anesthetic Warmer

- Benjamin Chasse
- Joshua Hamilton
- Nathan St. Jean
- Omar Alsamsam
- Michael Mason

1031. The Crichton Mouse: A New Model for ADHD Derived From ENU-Mutagenesis Screen

- Michayla Moore
- Yehya Barakat
- Vivek Kumar

1032. Understanding the Role of Prophage Encoded Polymorphic Toxins in Mycobacterial Superinfection Immunity and Drug Resistance

- Dakota Archambault
- Jaycee Cushman
- Maddie Kimble
- Sarah McCallister
- JC Ross
- Colin Welch
- Sally Molloy

1033. Progression of Cardiomyogenesis from Embryonic Stem Cells in a Three-Dimensional Gel Matrix

- Jonathan Bomar
- Dr. Scott Collins
- Dr. Rosemary Smith

1034. Analyzing and Characterizing the Strictly Lytic Infection of BPsΔ33 in Mycobacterium chelonae

- Matthew Cox
- Jaycee Cushman
- Sarah McCallister
- Emma Freeman
- Maddie Kimble
- Colin Welch
- Sally Molloy

1035. Using Telomerase Reverse Transcriptase to Study Brain Neurogenesis at Different Stages of Adulthood

- Joshua Passarelli
- Gabriel Jensen
- Kristy Townsend

1036. Development of Image Collection Apparatus for Color Band Analysis

- Theo Erikson
- Alia Parsons
- Oisin Biswas
- Raymond Perry
- Caitlin Howell

1037. Developing New Skills and Approaches to Authentic Research Experiences During COVID-19

- Jacob Cote
- Sally Molloy

1038. An Allelic Series of Spontaneous Mutations in Rorb Causes a Gait Phenotype, Retinal Abnormality, and Gene Expression Changes Relevant to Epilepsy, Bipolar and Autism Spectrum Disorders.

- George Murray
- Robert W. Burgess
- Abigail Tadenev

1039. Red Raspberry Consumption Counteracts Pathological Conversion of Perivascular Adipose Tissue in Rat Model of Metabolic Syndrome.

- Marissa McGilvrey
- Natalie VandenAkker
- Kimberly Malka
- Penny Clum
- Lucy Liaw
- Stefano Vendrame
- Dorothy Klimis-Zacas

1040. Characterizing Neuropathy Phenotypes and Gene Expression Changes Caused by Peripheral Myelin Protein 22 Overexpression in Mouse Models of Charcot-Marie-Tooth Disease 1A

- Audrie Langlais
- George C. Murray
- Timothy Hines
- Abigail Tadenev
- Kathy Miers
- Courtney Hatton
- Robert Burgess

1041. Impact of Exercise on Dystrophic Skeletal Muscle

- Amanda Ignacz
- Elisabeth Kilroy
- Ahmed Almaghasilah
- Kodey Silknitter
- Clarissa Henry

1042. Interferon Response Genes Expressed During the Innate Immune Response to Influenza A Virus

- Haley Foreman
- Julianna Grampone
- Riley Grindle
- Sarah Foust
- Brandy-Lee Sous
- Benjamin King

1043. Integrating Molecular Profiles with Clinical Outcomes in Cancer Patients from Rural Maine

- Michael Babcock

- Marek Skacel
- Benjamin King

1044. The Effects of BTS Induced Inactivity on a Zebrafish Model of Duchenne Muscular Dystrophy

- Sean Driscoll
- Clarissa Henry

1045. Nociceptive Sensitization in Larval and Adult Drosophila

- Christine Hale
- Samia Pratt
- Julie Moulton
- Geoffrey Ganter

1046. The Role of Cholinergic Interneurons in Impaired Cognitive Flexibility in Chronic Pain

- Megan Tomasch
- Makaela Rice
- Christoph Straub

1047. Localizing Neural Activity Within Murine Subcutaneous White Adipose Tissue (scWAT)

- Lydia Caron
- Josh Passarelli
- Sarrah Marcotte
- Dr. Leonard Kass
- Dr. Kristy Townsend
- Magdalena Blaszkiewicz

1048. Varying Rates of Nerve Spike Activity Recorded Within Mouse Subcutaneous White Adipose Tissue

- Sarrah Marcotte
- Josh Passarrelli
- Lydia Caron
- Leonard Kass
- Janice L. Pelletier
- Rosemary Smith
- Magdalena Błaszkiewicz
- Kristy Townsend

1049. Characterizing The Diversity of Cluster R Prophage in Mycobacterium Abscessus

- Colin Welch
- Maddie Kimble
- Dakota Archambault
- Claire Bourett
- Hector Orellana
- Andre Daigle
- Sally Molloy

1050. Collagen Microscopy Image Analysis Using Second Harmonic Generation (SHG)

- Christopher Roberts
- Betelhem S. Abay
- Karissa Tilbury

1051. Characteristics of Neural Electrical Activity Recorded Beneath the Skin in Diabetic Mice

- Joshua Passarelli
- Lydia Caron
- Sarrah Marcotte
- Leonard Kass
- Magdalena Blaszkiewicz
- Janice Pelletier
- Kristy Townsend

1052. Infection and Diet-induced Gut Dysbiosis: Impact on Sleep Fragmentation in Danio Rerio

- Ben Williams
- Robert Wheeler

1053. 3D Tracking of Muscle Precursor Cell Movement in Zebrafish

- Sabrina Varga
- Jared Talbot

1054. Epigenetic Effects of Dio3 Knock-Out Paternal Lineage on Fertility in Female Mice

- Logan Douglas
- Arturo Hernandez

1055. Loss of LOTR-1 Affects Germ Granule Movement in Germ Cells

- Madeleine Nowak
- Dustin Updike

1056. Study on the Synergistic Activity of Fluconazole and Cyclosporine A on Candida Albicans

- Maria Vina Lopez
- Robert Wheeler

1057. Investigating the Interaction of Streptococcus Agalactiae and Candida Albicans in Vitro and in Vivo

- Kathryn Patenaude
- Siham Hattab
- Robert T. Wheeler
- Melody N. Neely

1058. Delayed Healing and Nav1.8 Nerve Regeneration Following Corneal Injury in Sox11 Conditional Knock-out Animals

- Cara Sullivan
- Jun Lee
- Ian Meng

1059. Uncovering Candida Albicans Factors that Modulate the Host Phagocyte Response

- Bailey Blair
- Emma Bragdon
- Robert Wheeler

1060. Antimicrobial Agent Cetylpyridinium Chloride Interferes with Phosphatidylinositol 4,5-bisphosphate-protein Interactions in Influenza Infection Fibroblast Model and in Mast Cells.

- Prakash Raut
- Sasha Weller
- Bright Obeng
- Bailey West
- Christian Potts
- Julie Gosse
- Samuel Hess

1061. Defective CXCR4 Signaling Decreases Survival in a Zebrafish Model of Influenza A Virus Infection

- Brandy Soos
- Con Sullivan
- Paul A. Millard

- Carol H. Kim
- Benjamin L. King

1062. Optimizing RT-LAMP for Use in Wastewater COVID Testing
- Audrie French
- Kettie Rose Cormier
- Harrison Cyr
- Robert Wheeler

1063. Neurological and Muscle Fiber Health in Zebrafish Dystrophy and Dystroglycanopathy Models
- Mary Astumian
- Prakash Raut
- Sam Hess
- Clarissa Henry
- Erin C. Bailey

1064. The Role of Genetic Variation in Oocyte Preservation During Exposure to Chemotherapeutics.
- Rose Besen-McNally
- Zachary Boucher
- Ewelina Bolcun-Filas

1065. Yeast Actin Cytoskeleton Regulation by RGS
- Lucas Craig
- Cory Johnson
- Joshua Kelley

1066. Regulation of Septins Through Receptor-epsin Interactions
- Sarah Latario
- Cory Johnson
- Joshua Kelley

1067. Analysis of Cluster MabD Prophage
- Andre Daigle
- Colin Welch
- Sally Molloy

1068. Notch Signaling Regulates PVAT Function During Diet-induced Obesity
- Chenhao Yang

- Anne E. Harrington
- Larisa M. Ryzhova
- Lucy Liaw

1069. Anti-fungal Treatment Efficacy During Polymicrobial Infection

- Siham Hattab
- Jennifer Quezada-Loja
- Anna Maria Dagher
- Avery Bond
- Robert Wheeler

1070. Development of a Novel RAB27a Knockout Strain to Study Adipose-Vascular Signaling in Vivo

- Ashley Soucy
- Larisa Ryzhova
- Anne Harrington
- Benjamin Tero
- Bethany Fortier
- Lucy Liaw

1071. Mycobacterium Abscessus Cluster R Prophage Genomic Analysis

- Madeline Kimble
- Colin Welch
- Dakota Archambault
- John Ross
- Jacob Cote
- Sally Molloy

1072. Characterization and Comparative Analysis of Prophage in Antibiotic Resistant Mycobacterial Genomes

- John Ross
- Madeline Kimble
- Colin Welch
- Anna Schumann
- Dakota Archambault
- Sally Molloy

1073. Antimicrobial Agent Cetylpyridinium Chloride Inhibits Immune Mast Cell Function

- John Burnell
- Bright Obeng

- Christian M. Potts
- John E. Burnell
- Bailey E. West
- Julie Gosse

1074. Distance Vitals

- Kiana Goodwin
- Callie Witt
- Allie Nutting
- Ethan Saville
- Michael Mason
- Robert Bowie

1075. Low Dose Arsenic Exposure Alters the Expression of MicroRNAs in the Innate Immune Response to Pseudomonas aeruginosa Infection.

- Liz Saavedra Perez
- Brandy L. Soos
- Carol H. Kim
- Benjamin L. King

1076. Computational Analysis and Classification of SHG Images of Cancerous Pancreatic Tissue Based on Collagen Fiber Alignment

- Gerren Welch
- Karissa Tilbury

1077. Investigation of the Relationship between Black Soldier Fly Larvae Pathogen Suppression and Growth Substrate in Relation to Maine Agricultural Industries

- Haley Morrill
- Marissa Kinney
- Emily McLaughlin
- Matthew Moyet
- Edward Bernard

1078. Comparative Genomic Analysis of Prophages in Clinical Isolates of Streptococcus agalactiae

- Caitlin Wiafe-Kwakye
- Andrew Fournier
- Katie Southworth
- Hannah Maurais
- Brandon Rockwell

- Caiden Fraser
- Melody Neely

1079. The Effects of Common Water Contaminants on Zebrafish Mitochondria Function and Behavior

- Audrie French
- Noah Burby
- Grace LaFrance
- Patrick Fleming
- Marc Thibodeau
- Remy Babich

1080. The Optimization of RT-LAMP Testing from Wastewater for SARS-Cov-2 Detection

- Harrison Cyr
- Kettie Cormier
- Audrie French
- Robert Wheeler

1081. Dynamic Regulation of Metabolism by the Glucocorticoid Responsive Gene Klf9

- Ian Gans
- Remy Babich
- Nishad Jayasundara
- Jim Coffman

1082. Pseudomonas aeruginosa Infection Interacts With NF-κB Activation Through Integrin Signaling

- Daisy Drinkert
- Jon Donnelly
- David Flewelling
- Victoria Mayers
- Sabrina Varga
- Benjamin King

1083. Differential Gene Expression in Developing Zebrafish Glomeruli

- Daemon Dikeman
- Iain Drummond

1084. Role of cAMP-pathway Regulators on Acute to Chronic Pain Transition

- Zaid Al-Abbasi

- Ramaz Geguchadze
- Katherine J. Motyl
- Derek Molliver

1085. Characterizing the Role of Neuroblastoma Suppressor of Tumorigenicity 1 (NBL-1) in Progression of Kidney Disease in Mice

- Teresa Easterbrooks
- Yuka Takemon
- Kristina O'Neil
- Andrzej Krolewski
- Ron Korstanje

1086. Investigating the Link Between Aging-Related Vascular Dysfunction and Peripheral Neuropathy through Pressure Myography

- Bailey Woodard
- Jake Willows
- Kristy Townsend

1087. Concentration-dependency of Suppression of B. Cereus and MRSA using Black Soldier Fly Larvae in Potato Waste

- Daniella Leal Espinal
- Edward Bernard

1088. Receptor Endocytosis Regulates Septin Distribution in Yeast

- Cory Johnson
- Sarah Latario
- Joshua Kelley

Physical and Mathematical Sciences

Projects 101 - 113

Physical and Mathematical Sciences

101. Luminosity Functions of Galaxy Clusters in the Aquarius and Microscopium Superclusters

Submission Category: Physical and Mathematical Sciences

Author(s): Logan Hess

Faculty Mentor: David Batuski

Abstract:
We examine physical properties of several galaxy clusters located within the Aquarius (AQR) and Microscopium (MSC) super-cluster complexes via their luminosity functions, fitted using Schechter functions. Images of clusters were acquired via the DECam imager of the 4-meter diameter telescope at CITO (Cerro Tololo Inter-American Observatory). We observe six clusters in our sample; four from the Aquarius supercluster (AQR 2541, 2546, 2554, 2555) and two from the Microscopium supercluster (MSC 3695, 3696). Magnitude information and density of member galaxies in each cluster was extracted via the SExtractor software utility. We correct for background by sampling and subtracting under-dense regions of our images. We construct luminosity functions (observations of magnitude vs cluster density) for each cluster in our sample. Schechter functions are fitted to luminosity functions via chi-squared minimization. Fitted Schechter parameters α (characteristic slope) and m* (characteristic magnitude) of samples are compared to parameters derived from other publications of clusters of different environments and redshift.

102. Exchange Functionals and Basis Sets for Density Functional Theory Study of ZnO Nano clusters in Photocatalytic Reactions

Submission Category: Physical and Mathematical Sciences

Author(s): Duwage Perera

Faculty Mentor: Jayendran C. Rasaiah

Abstract:
Nano scaled ZnO clusters used as catalysts can push the limits of many industrial applications of chemical reactions in the manufacture of paints, cosmetics, and pharmaceuticals. The clusters act as semiconductors with a wide band gap 3.4 eV at 300 K, and they are prospective photocatalysts

in many applications including H2 production in water splitting reactions. In this project, we studied the structural (geometry) and electronic properties (vertical detachment energy and electron affinity) of ZnO monomers and dimers to form several different model ZnO clusters using density functional theory (DFT) with many different exchange functionals and 29 basis sets. We compared the singlet-triplet energy gaps of small ZnO clusters to find the most efficient ZnO cluster and the best theoretical method to investigate their photocatalytic water splitting activity.

Our results show that B3LYP/DGDZVP2 level of exchange functional/basis set theory is the most efficient and fastest method to analyze the catalytic activities of ZnO nanoclusters. Comparison of the singlet-triplet energy gap shows that the trimer (ZnO)3 (with 58.66 k cal/mol energy gap approximately equal to the energy of a visible photon at~555 nm) and a HOMO-LUMO gap of 4.4 eV is the best amongst the clusters of different size. We used the Gaussian16 software package (Installed on the UMaine Computer Cluster) for all the calculations.

103. Characterization and Modification of Cellulose Nanofibrils for Green Composites

Submission Category: Physical and Mathematical Sciences

Author(s):
- Peter Kelly
- William Gramlich
- Douglas Gardner

Faculty Mentor: William Gramlich

Abstract:
Cellulose nanofibrils (CNFs) derived from woody biomass are promising candidates for use as composite reinforcements due to their high strength and inherent biodegradability. Their unique morphology allows them to form networks throughout the composite, assisting load transfer and reinforcing the underlying polymer matrix. The characterization of this hierarchical morphology has proven challenging, due to the orders of magnitude differences in the sizes of fibrils present. A method for the characterization of CNF morphology at multiple length scales has been explored and applied to the production of nanofibrils derived from northern bleached softwood kraft pulp and old corrugated container material. Atomic force, scanning electron, and optical microscopy have been used to characterize fibril dimensions throughout the refinement process to better understand the changes occurring. Additionally, polymeric modifications to the CNF surface, achieved via a grafting-through approach, have been carried out using a library of

(meth)acrylate and (meth)acrylamide monomers. These modifications and the effects they have on the morphology of the CNF substrate have been studied and will be discussed.

104. Application of Machine Learning Techniques to Classify and Identify Galaxy Merger Events in the CANDELS Fields

Submission Category: Physical and Mathematical Sciences

Author(s): Alex Koch

Faculty Mentor: David Batuski

Abstract:
A random forest classifier written in the Python coding language was applied to images of a subset of galaxies from the Cosmic Assembly Near-infrared Extragalactic Legacy Survey (CANDELS) to classify merger and non-merger events. 226 merging and 226 non-merging galaxies were selected from four CANDELS fields, totaling a combined 452 galaxies for training and validation. The classifier was trained on a set of parameters measured for each galaxy, including mass, star formation rate, galactic half-light radius, as well as Concentration and Asymmetry measurements, for 339 galaxies using five-fold cross-validation. The remaining 113 galaxies were used for testing and validation. The classifier performed with a mean accuracy of 92.31% and a precision of 93.32.

Additionally, preliminary work has been completed training a Computer Vision convolutional neural network to analyze and classify images of merger and non-merger events in the same fields. Due to the small number of merger events, data augmentation has been done to increase the dataset significantly to boost performance. Currently, the classifier performs with an accuracy of 85.66% and a precision of 85.23, although optimization of the classifier is ongoing.

105. Surface Modification of Cellulose Nanofibrils Using Water Soluble Monomers and Subsequent Surface Polymer Characterization

Submission Category: Physical and Mathematical Sciences

Author(s):

- Peng Cheng
- Peter Kelly
- William Gramlich

Faculty Mentor: William Gramlich

Abstract:
While efforts have been taken to introduce more biodegradable plastics into the commercial space, many modern biodegradable plastics lack the rigidity necessary to substitute the nonbiodegradable plastics in use today. Cellulose, a naturally abundant reinforcing agent, cannot normally be effectively integrated into plastics due to poor interfacial interactions. Our research shows that cellulose nanofibrils (CNF) can undergo surface modifications by attaching various polymers to CNF, which may improve interfacial interactions between CNF and plastic materials. To further study these interfacial interactions, a method to detach the polymers on modified CNF must be investigated in order to streamline surface polymer analysis. This project seeks to synthesize fresh polymer-functionalized CNF using various water soluble monomers, then develop and enact a surface polymer characterization method to further research polymer-functionalized cellulose. A two-step grafting-through copolymerization scheme is used to synthesize polymer-functionalized CNF. Experiments show that poly(n-isopropyl acrylamide), polyacrylamide, polymethacrylamide, poly(acrylic acid), poly(methacrylic acid), and poly(2-hydroxyethyl methacrylate) can be successfully grafted onto CNF. Methods to separate grafted copolymers from polymer-functionalized CNF under basic and acidic conditions are under investigation.

106. Analyzing Nonsmooth Sensitivities in Graph Centrality Problems

Submission Category: Physical and Mathematical Sciences

Author(s): Jon Donnelly

Faculty Mentor: Peter Stechlinski

Abstract:
Agent based ratings are an incredible mechanism to evaluate the importance of a given agent in many network structures. Peer-to-peer (P2P) networks, which distribute the burden of software sharing across multiple computers, have consistently risen in prominence and rely on such schemes to provide security. With richly interconnected, but decentralized structures, P2P networks often operate based on the trustworthiness of each agent in the network in a democratized way. Typically this is accomplished using algorithms based on matrix theory, such as the EigenTrust algorithm which is built from Google's PageRank search engine algorithm. In this scheme, agents assign individual trust scores to one another, which then propagate through the network and eventually generate a global trust score for each user; these individual trust scores may be assigned as negative (distrust) or positive (trust). Eventually, a consensus is

reached between agents which corresponds to the principal eigenvector of a matrix representing the network. This consensus value, however, may be vulnerable to manipulation; because network members provide the baseline ratings, a group of malicious actors could carefully choose the scores they assign to reduce the score of a target actor. We are interested in analyzing the sensitivity of these trust scores to changes in the network, to determine the viability of such attacks. We apply recently developed theory called lexicographic differentiation to compute parametric sensitivities, which can be used in, for example, optimizing the network against malicious actors who aim to engineer the network.

107. The Impact of Natural Rubber as a Toughening Agent on the Strength, Degradability, and Toxicity of an Algae-Based Bioplastic

Submission Category: Physical and Mathematical Sciences

Author(s): Megan Driscoll

Faculty Mentor: William Gramlich

Abstract:
In recent years, the negative impact of petroleum based plastics on human health and the environment has become increasingly clear. Due to mismanaged waste systems, billions of tons of plastic waste has infiltrated both terrestrial and marine ecosystems across the globe. These plastics leech harmful substances into the environment, cause animal ingestion and entanglement, and break down into microplastics that are then biomagnified up the food chain, resulting in human consumption. However, the use of plastics have been revolutionary in science, medicine, and daily life, even benefiting the environment in many ways. Therefore, rather than ridding the world of plastics altogether, a promising solution has come in the form of bioplastics, or plastics made from renewable materials. Current bioplastics, such as PLA, are limited in application due to their brittle nature. Additives, like glycerol plasticizers, are often added to offset brittleness, but sacrifice strength in return. In place of glycerol, Natural Rubber, an elastomer, can be used as a toughening agent to benefit both the durability and strength of the plastic. This project looks at the impact of Natural Rubber on the strength, degradability, and toxicity of an agar-based bioplastic. Thiol-norbornene modifications were used to couple the agar and the natural rubber. Six film formulas were made to understand the impact of each step of the modification process. The viability of the films was determined using tensile strength analysis, a four-week degradation study, and a bioassay using Artemia sp. as a model organism for short-term toxicity.

108. Discerning the Distribution of Dark Matter via Weak Lensing in Extremely Dense Supercluster Environments

Submission Category: Physical and Mathematical Sciences

Author(s): Sarah Rice

Faculty Mentor: David Batuski

Abstract:
It is well known that, on large scales, the Universe is composed of a vast network of galaxy filaments and voids. Since dark matter interacts gravitationally, it stands to reason that it should be distributed in a similar manner as luminous matter. In this project, we analyze the shapes and orientations of faint (very distant) galaxies to construct weak lensing maps of two extremely overdense supercluster regions using data gathered from our 2015 observation program. The images analyzed to create these maps were taken using the 500 megapixel Dark Energy Camera on the 4-meter telescope at Cerro Tololo Inter-American Observatory in Chile.
We then compare each map to a model of the lensing expected from the galaxy clusters within each of our two supercluster images. The results thus far show statistically significant agreement for the orientations of the lensing effects between the data and the model. This suggests a lack of possible massive dark matter filaments connecting the galaxy clusters in each supercluster region.

109. Cyanide Detection in Water Using Infrared Spectroscopy

Submission Category: Physical and Mathematical Sciences

Author(s):
- Kirsten Dennen
- Nayeem Ibnul

Faculty Mentor: Carl Tripp

Abstract:
Cyanide is an extremely toxic ion which often contaminates drinking water from industries such as mining, steel and iron manufacturing, and wastewater treatment. If ingested or inhaled, cyanide prevents cells from using oxygen, leading to cell death. Health effects can range from dizziness to loss of consciousness and respiratory failure. Long term exposure can lead to heart and brain damage. The Environmental Protection Agency (EPA) sets the limit for cyanide in

drinking water at 0.2μg/mL, or 0.2ppm. The goal of this project is to develop a method to detect cyanide at concentrations below the 0.2ppm limit, while also allowing samples to be tested in the field, quickly and cost efficiently. In this method cyanide is precipitated from a water sample using silver nitrate, and a given volume of the sample is passed through a membrane. This membrane concentrates the solid cyanide from the effluent. An infrared spectrum is then recorded directly off the membrane. A band on the spectrum corresponding to cyanide measures how much infrared radiation was absorbed by the solid cyanide. Using this absorbance value, Beer's Law calculations can be performed to determine the concentration of cyanide that is present in the water sample.

110. Colloidal Interactions to Generate Latex Coated Pigment for Paper Coating Applications

Submission Category: Physical and Mathematical Sciences

Author(s): Pradnya Rao

Faculty Mentor: Carl Tripp

Abstract:
Latex binders are the costliest components in the coating. A cost-effective paper production approach made industry efficient utilization of binder without compromising with the coating strength and paper quality. In this proposed work, we are implementing an innovative industrially scalable approach of layer by layer techniques using electrostatic interactions to form a pigment binder composite in the solution phase as a conceivable method for lesser and effective use of the binders. Coating formulations are generated using cationic precipitated calcium carbonate (PCC) pigments as a core and it is mixed with anionic styrene-butadiene (SB) latex binders to form monolayer adsorption of binder particles on the pigment. The migration of latex binder in coatings generated on various substrates under various drying conditions was measured using Raman spectroscopy and compared with reference coatings consisted of anionic pigment and anionic binder. For most cases, the new system showed reduced latex binder migration than those obtained with the reference coating. The coated papers were also measured for strength, opacity, gloss, water drainage rate, and porosity. Little difference is seen in the picking strength of the coating and gloss compared to coatings prepared with standard formulations. Water drainage rate, opacity, and porosity were higher for latex coated pigment coatings than the reference standard coating; this increased porosity is likely due to the strong electrostatic interactions present in the coatings.

111. UMCS Lab Help Center

Submission Category: Physical and Mathematical Sciences

Author(s):
- Jeremy Hutchinson
- Chad Berry
- Nate Gagnon
- Cooper Dahlberg
- Isaac Sparks-Willey

Faculty Mentor: Penny Rheingans

Abstract:
In order to assist with the operation of the Boardman Hall Computer Science lab, we at Diamond Tech are in the process of developing a web application that will allow students to request help, both in person and remote through zoom or discord, from lab staff in a structured and organized way. The Computer Science lab, located in Boardman room 138, is a common use lab available to all computer science students. The lab is often utilized for working on assignments or personal projects as a group, and computer science TAs and professors are available throughout the week to provide feedback and support when needed.
Our application, the UMCS Lab Help Center, will assist lab staff by keeping track of requests for help, and data about requests will be stored and analyzed to provide insight into when and with what computer science students require help. The Help Center will help lab staff assist students as well as inform computer science instructors when a large number of students from their course are seeking help. We are developing the Help Center as part of the computer science capstone program. We are using an agile development process that resembles the V-model of software development, meaning development takes place over two week periods followed by a meeting to discuss progress.
Documentation and planning began with an overview, and as development progressed the scope focused down to specific architecture planning. After planning was complete, we moved to implementation, starting with a very focused scope and then integrating each component with the others.
The architecture of the Help Center is being developed following the model-view-controller model which organizes components of the application into three separate categories that only interact when necessary. Components of the system that involve user interaction are separated from internal representation of concepts, which are again separate from the final view shown to the user.

112. Conjugation of Glycans with Versatile Anthranilamide Auxiliary

Submission Category: Physical and Mathematical Sciences

Author(s): Angel Nieves

Faculty Mentor: Matthew Brichacek

Abstract:
Glycans and correspondingly glycan-binding proteins carry out critical functions in the maintenance of the cell, tissue structure, signal transduction, cellular recognition and tentatively stem cell differentiation. Although many studies have investigated glycans, there is minimal understanding of their involvement, role, and importance at a molecular level. Novel glycan auxiliary N-(2-ThioEthyl)-2-AminoBenzamide (TEAB) was synthesized in two steps from commercially available isatoic anhydride and cystamine. The nucleophilic acyl substitution required extensive optimization in the isolation and purification process. Subsequently, the reduction of the disulfide of TEAB necessitated a screening of reducing agents. Ultimately, zinc powder was found to produce the desired product in the highest yield and easiest isolation process. With a scalable synthesis of TEAB, the auxiliary was conjugated to a variety of glycans with picoline-borane complex in yields ranging between 50-96%. Future efforts will utilize the assembled glycan library to study specific glycan-associated biological processes allowing an understanding of their role in the human body and disease.

113. Synthesizing Hydrogels from Norbornene-Functionalized Hydroxypropyl Cellulose

Submission Category: Physical and Mathematical Sciences

Author(s): Lauren Andrews

Faculty Mentor: William Gramlich

Abstract:
Hydrogels are three-dimensional networks of crosslinked polymers that display a high water affinity, allowing for absorption of large amounts of water into the polymer network. While already having numerous applications in industries such as medicine and cosmetics, common methods for synthesizing hydrogels often require non-sustainable materials and may have toxic byproducts formed during gelation. Using cellulose, which is the most abundant biopolymer on Earth, to create hydrogels solves these problems by using a sustainable, biologically inert starting polymer that produces no harmful gelation or degradation byproducts. The goal of this research,

under the guidance of Dr. William Gramlich in the Department of Chemistry, is to synthesize hydrogels from norbornene-functionalized hydroxypropyl cellulose (cHPC) by altering the concentration of the crosslinking agent and then conducting rheological studies on the gels. The results of mechanical testing will determine if the mechanical properties of cHPC hydrogels can be precisely tuned by changing these initial reaction conditions.

Business

Projects 201 - 206

Business

201. Sustainability in Clothing Consumption

Submission Category: Business

Author(s): Katelynn McFadden

Faculty Mentor: Erin Percival Carter

Abstract:
In this research, I examine how objective and subjective consumer knowledge about the effect of clothing on the environment affect consumer judgments and decisions. Since 2000, the average person has increased the amount of clothing he or she purchases by 60 percent but only kept each garment for half as long (Burgess, 2019). This recent change in consumer behavior has been dubbed “fast fashion” and with consumer trends cycling so quickly, has contributed to huge amounts of clothing related waste in landfills thereby negatively impacting the environment. Minimalism and upcycling are rising in popularity as consumers become more concerned about their individual impacts on the environment. In response, some retailers have invested in producing more “sustainable” product lines, such as Green Eileen and Patagonia (CFDA, 2019). However, very little research in consumer behavior has systematically examined the role of consumer knowledge (objective and subjective) in predicting consumer reactions to retailer claims about the sustainability of apparel. I contribute to this conversation by examining how consumers’ subjective appraisal of their knowledge versus an objective measure of their knowledge about the impact of their clothing purchases drive preferences to 1) purchase second-hand clothing and 2) pay a premium for clothing associated with vague versus specific claims about sustainability. I examine these questions using a behavioral experiment conducted using an online panel of participants. I conclude by discussing the implications of my research for both sustainability-minded consumers and retailers.

202. The Importance of a Checkmark: An Investigation into the Perceptions of Social Media Verification and its Effects on Consumer Trust

Submission Category: Business

Author(s): Jazlyn Dumas

Faculty Mentor: Stefano Tijerina

Abstract:
Media giants, among them Facebook, Instagram and Twitter, support verified accounts. Verification, denoted by a blue checkmark badge visible in search and on one's profile, is ostensibly a way of confirming one's identity, yet only accounts with large followings are awarded verification status by the platform. This research investigates the perception of verification in the context of paid partnerships with social media influencers, a topic relatively absent from the literature despite the billions of dollars spent on influencer partnerships. Verified influencers cost more, since verification is correlated with a higher following. Therefore, this research could allow brands to capitalize their ad return if they are made aware of the implications associated with verification. Specifically, I investigate if consumers perceive verification as more directly associated with credibility or celebrity and if this relationship yields discrepancies in consumer's trust of the brand, advertisement, and endorser in paid partnerships on social media. Two questionnaires administered via Amazon's Mechanical Turk tested two hypotheses. 342 respondents completed a pre-test that tested, and proved true, the assumption that verification is viewed as the same regardless of platform. In the primary study, 413 participants were randomly assigned to one artificial Instagram post in a 2 x 2 between-subject design: (beauty vs. fitness industry) x (verified vs. unverified). Surprisingly, results indicated that verification had no impact on user's perceptions of credibility or trust suggesting that participants viewed all endorsers, regardless of verification, as celebrities rather than influencers. Interestingly, verification did play a significant role in user's perceptions of endorser attractiveness and verified endorsers were viewed as less attractive. Given the findings, supplemental, future research and implications are discussed.

203. The Effects of Payment For Order Flow on Capital Markets and Investor Money

Submission Category: Business

Author(s): Abdullah Karim

Faculty Mentor: Stephen Jurich

Abstract:
The rapid evolution of technology changed how humans interact within financial markets. Many brokerages have opted to virtualize their trading processes, allowing anyone to trade with ease. The virtualization of capital market transactions has disrupted many traditional business models, causing brokerages to rethink their revenue streams. Almost all online brokerages have adopted a model for generating revenue called Payment for Order Flow (PFOF). This model dictates that orders for stocks and options will be routed to market makers who pay brokerages for the order volume so that they can execute the transactions and profit off of the spread between the bid and

ask prices of a stock or option bought or sold. One other way that market makers can use these orders are by routing them to traditional stock exchanges such as the New York Stock Exchange and the Nasdaq rather than Dark Pools. This arrangement is profitable as many traditional exchanges work off a maker-taker transaction model, where companies get paid to make liquidity in markets and taking liquidity costs money. With PFOF, online brokerages have the opportunity to give retail investors access to zero-commission trading, but with this new business model, brokerages are the ones profiting due to the value of order flow to makers. This research aims to explain the mechanics of PFOF works, pros, cons, and plans to elicit useful metrics for understanding where investor money is really flowing with PFOF.

204. The Emergence and Role of the IEX in Market Fragmentation

Submission Category: Business

Author(s): Cameron Spicer

Faculty Mentor: Stephen Jurich

Abstract:
Over the past several decades, the secondary market for equity securities has evolved into a more complex and fragmented system than it once was. The Investor's Exchange (IEX) emerged in 2014 in rebellion of purportedly unethical High-Frequency Trading (HFT) behaviors in the markets. Using a novel, proprietary model for trade matching along with providing other services, the IEX has become a respectable player in the National Market System that prides itself on transparency and fairness. The IEX "Speed Bump" model has been imitated by exchanges as seen in the NYSE American Stock Exchange, the Chicago Stock Exchange LEAD program, and the Nasdaq Extended Life order designation. This paper explores the role that IEX has played in market fragmentation since its inception using empirical and historical analysis. The empirical analysis focuses primarily on a recent two-year time period spanning from August 13th, 2018 through August 13th, 2020. Using difference in means tests, this paper makes comparisons between the IEX and NYSE American, the two most reputable "speed bump" models. In-depth review of existing literature offers further insight about the IEX and its relationship to trends in market microstructure. Further discussion in the analysis highlights regulatory, evolutionary, and ethical implications of the IEX and its impact on the market system.

205. Understanding Patterns of Underdevelopment Within the Union: A Dive Into the Competitiveness of Individual States in a Global Marketplace.

Submission Category: Business

Author(s): Karim Seifeldein

Faculty Mentor: Stefano Tijerina

Abstract:
This research project set out to understand how each state in the union would fair when compared to countries around the world. Hoping to discover any correlations, that may have been previously unknown. While, realistically depicting the competitiveness of each of the 50 states within the global hierarchy. For this project we chose to focus on five themes, Size of the Economy, Quality of Life, Poverty, Health, Research & Development and Technology, because these are the U.N. development measurements for determining whether or not a nation is part of the advanced industrial world. The objective was, to understand if underdevelopment was a systematic problem, or simply an issue that only affects developing regions of the world.
Data was gathered from the World Bank, UNESCO (United Nations Educational, Scientific and Cultural Organization), The United States Census, The Bureau of Economic Analysis, The CDC (Center for Disease Control) and more. The data was then sorted into what became the five themes and their subcategories, to obtain a snapshot view of how the states and countries compared. Each category was benchmarked with a formula that allowed for a more direct and comparative analysis.
Understanding who the competition is and how to compete has never been more important. In an ever-growing global marketplace, utilizing your strengths while working to address potential weakness is the only way to stay relevant and competitive in a global market system. More so, identifying levels of disparity within nations themselves, as in the case of the USA.
This research set out to prove that pockets of underdevelopment exist in the USA. While we found that areas of underdevelopment do exist in the USA, the research also showed that when compared with other areas around the world, individual states are more competitive on the global scale than previously realized.

206. Bitcoin Derivative Trading Volume and the Impact of Foreign Government Shock

Submission Category: Business

Author(s): Jonathan Libby

Faculty Mentor: Stephen Jurich

Abstract:
Bitcoin and cryptocurrency as a whole has become increasingly important in finance markets. Supporters claim digital currencies will give birth to a new form of finance and monetary policy for the world. With this sudden jump in interest in a volatile and unregulated market, governments are actively exploring ways to protect investors from unregulated financial assets. An example of these government protections is the FCA ban of retail trading in crypto derivative markets in the UK. This landmark decision is the first of it's kind and has regulators uncertain how markets will react. This study aims to research the impact of derivative trading volume in US markets and the impact the government regulatory shock of the UK ban on crypto derivative trading volume impacts US Derivative trading markets in cryptocurrency.

Education

Projects 301 - 312

Education

301. Assessing the Effectiveness of a Tool for Classifying and Assessing Student Energy Diagrams in Pre- and Post-COVID-19 Instruction

Submission Category: Education

Author(s): Michael Dudley

Faculty Mentor: Michael Wittmann

Abstract:
Energy is a broad concept that is used to interpret and understand scientific phenomena, and appears throughout the Next Generation Science Standards (NGSS) at all grade levels and across disciplines. The NGSS specifies no single approach for energy instruction, and makes use of different energy metaphors, often within individual standards. Gray, et al. (2019) created a checklist (the "Gray Checklist") to identify whether or not a diagram exhibits evidence of core constituent ideas that align to the energy model of the NGSS. This study used the Gray Checklist to find trends in student energy diagrams that were produced during a course of ordinary classroom instruction on energy in two college-preparatory physics classes in the Spring of 2019 and the Spring of 2020.

The Gray Checklist effectively detected fulfillment of energy constituent ideas; however, several trends in the diagrams went undetected by the Checklist. Diagrams tended to show organization along temporal or position-based narrative structures, which implies the importance of building the energy state of objects into energy diagrams. Certain diagrams also broke with diagramming protocols in order to express energy tracking ideas that the Gray Checklist construes as a violation of conservation of energy. Diagrams also tended to exhibit use of diverse forms of energy in situations not typical of high school energy instruction.

These results suggest changes to the Gray Checklist and implications for teaching and learning regarding energy instruction and the use of energy diagramming schemes in the classroom. Further implications regarding the NGSS and its energy model are also derived from these results. Future work can include creating performance standards for energy diagrams and developing a paradigm of energy as a modeling technique rather than a static set of content standards in the NGSS.

302. Youth Relevance in a Science Learning Setting

Submission Category: Education

Author(s): Gabrielle Brodek

Faculty Mentor: Elizabeth Hufnagel

Abstract:
The field of science education focuses on the concept of relevance in terms of application rather than student conceptions, considering it retroactively rather than embedding it in the curriculum and as part of the lesson planning process. Because any and all emotions indicate a personal connection, emotional expressions indicate how individuals are experiencing relevance. In this research relevance is defined as how youth connect with and make sense of scientific ideas, bounded by what is productive and disciplinary. By exploring how youth experience relevance in science, educators can teach to it, therefore teaching to the individual's own sense making. The research questions for this study are: (1) what does relevance look like in a science learning setting? and (2) how do youth experience relevance when learning about sustainable fishing? To answer these questions youth's emotional expressions will be analyzed in the discourse of virtual afterschool club meetings. Data sources include video recordings and field memos from each Zoom meeting, as well as youth artifacts, including virtual collaboration board and reflection question responses. Analyzing emotional expressions, bounded by what is productive and within the science discipline, allows us to make salient how youth are experiencing relevance and making sense of science through talk and text. This presentation will illustrate how relevance is defined and bounded in a science learning setting, and how discourse analysis can be used to uncover how learners experience relevance when learning about sustainable fishing.

303. The Other Side of the Screen: Understanding the Experience of Adult Learners in Online Learning

Submission Category: Education

Author(s):

- Anne Fensie
- Jennifer Jain
- Teri St. Pierre

Faculty Mentor: Asli Sezen-Barrie

Abstract:
In Maine, adult learners (age 24+) are quickly becoming the majority in the student body of online courses, and many are adults with multiple roles, like employees and caregivers. These roles contribute to lower rates of persistence to degree completion. The gap in the literature describing the lived experience of adult learners in distance education led us to study this population. In this collective case study, four high-achieving working mothers who were experienced in distance learning were recruited. Students were interviewed and then instructed to record their study sessions using screencasting and webcam with audio. Weekly debrief sessions were held in addition to follow-up interviews where students reflected on clips from their recorded sessions. Interview transcripts were analyzed using process codes in the constant comparative method. Video analysis began with a review of all study sessions for a macro view of the data, followed by detailed analysis of embodied actions. Annotations were coded for the source of distraction, type of distraction, the activity interrupted, and the level of student engagement. These students experienced distractors in their study environment for nearly half of the recorded time. The main source of distraction was their children; however, each of the students described an ability to "tune out" many of their distractors and remain engaged in their coursework. Instructional design played some role in their ability to remain focused during learning activities. These findings are important for those planning distance education instruction and support of adult learners.

304. An Analysis of Citizenship Education Efforts in Maine Middle Schools

Submission Category: Education

Author(s): Tom Adams

Faculty Mentor: Rebecca Buchanan

Abstract:
An essential responsibility of public schooling is to cultivate civic awareness in students and prepare them to participate in a democratic society. Schools have, however, broadly failed this task, a trend the Maine Department of Education has attempted to reverse through policy. The 2019 edition of the DoE's Maine Learning Results ("MLR") standards mandates that middle school social studies curricula implement civic action and service-learning projects (a.k.a. "citizenship education") to address community needs and foster students' civic identity.

Existing literature suggests that citizenship education improves students' civic and community engagement, but the effectiveness of this new policy—particularly in the context of the coronavirus pandemic—is unmeasured. My research analyzes the implementation, quality, and

impact of citizenship education projects undertaken by Maine's middle school social studies teachers in response to the MLR.

With my advisor, Dr. Rebecca Buchanan of the College of Education, I have developed a research method that aims to understand citizenship education in Maine more fully. Data collection has occurred over two phases, the first of which was a survey sent to every sixth-through-eighth-grade social studies teacher in Maine concerning the types of citizenship education projects they've implemented. The second phase, presently ongoing, consists of interviews with select survey respondents to gain in-depth information about their projects and the contextual factors influencing their implementation. Preliminary findings have shown a broad range of projects happening in schools, though few have been directly influenced by the MLR. Additionally, teachers largely believe the state should provide more robust curricular supports.

305. Supporting and Exploring the Nature of Student Reasoning: Examining the Impact of Relative Salience on Intervention Effectiveness

Submission Category: Education

Author(s): Ryan Moyer

Faculty Mentor: MacKenzie Stetzer

Abstract:
Research suggests that student performance on certain physics questions may be impacted by the nature of human reasoning. In this project, we have been using dual-process theories of reasoning to investigate student reasoning on physics questions with salient distracting features. We were particularly interested in exploring the impact of the relative salience of those features on student reasoning, and the extent to which asking students to consider alternative approaches impacted performance. Research tasks were administered to students in the introductory calculus-based physics sequence. The sequence included a pre-task in which students were asked to determine whether or not a number of initial approaches would be useful to answer a given physic question, the target task in which they were asked to construct a reasoning chain in order to answer that question, an intervention in which they predicted the answer a fictitious student would reach based on a different initial approach, and an opportunity to revisit the original question. Students were randomly assigned one of two versions of the sequence in which the relative salience of the salient distracting feature was varied. Our results have shown that relative salience can have a significant impact on not only students' ability to reach the correct conclusion, but also their ability to construct alternative lines of reasoning. These findings

further highlight the role that the nature of human reasoning may play when students answer physics questions.
This material is based upon work supported by the National Science Foundation under Grant Nos. DUE-1431940 and DUE-1821390

306. My Life, My Plan

Submission Category: Education

Author(s):
- William Faunce
- Quinn Severs
- Dawsin Blanchard
- Dylan Bulmer

Faculty Mentor: Terry S. Yoo

Abstract:
Deciding on a postsecondary plan is not always easy for students. A student's plan for life after high school will differ from other students, so one solution will not work for everyone. The goal of the "My Life, My Plan" project is to develop a platform where high school students can choose their desired postsecondary path and receive a set of steps that are necessary to ensure that plan happens for them post-graduation.

Our team, Stillwater Software, have defined the following concepts for the project:
Plans: a sort of "pathway" composed of Modules with the end goal being a student's postsecondary desire.
Module: a task within a Plan for the student to complete before they move onto the next step.

Students select a Plan and are given a list of Modules they must complete for a given school year. To complete a Module, students submit work that is then reviewed and approved by an advisor. Staff will be able to keep track of student progress so that they may help with and celebrate the steps students have taken toward their future.

For development of My Life, My Plan, we have opted to create a web application that will run in both desktop and mobile internet browsers, thereby increasing accessibility for users. Once the project is completed, we expect to deploy an instance of the application at a local Maine high school where it will be used to help students decide what they want to do in life.

307. Arguing Within and Beside a Pyramid: How Can Virtual-Reality be Used to Learn Geometry?

Submission Category: Education

Author(s): Camden Bock

Faculty Mentor: Justin Dimmel

Abstract:
In school geometry, representations mediate learners understandings of mathematical concepts. Diagrams are a type of graphical representation that can be used to show spatial and theoretical properties of mathematical figures. Diagrams are commonly used by learners to reason and construct arguments about concepts in geometry, and are often composed on two-dimensional surfaces (e.g., chalkboards, textbooks, computer screens). Research has explored how digitally rendered diagrams can show geometric transformations as a continuous processes that can relate a collection of mathematical figures through animation and click-and-drag interactions. Immersive virtual-reality environments offer the dynamic potential of digital renderings in a three-dimensional space. When used to render diagrams, these environments allow learners to use their bodies to interact with three-dimensional representations of geometric objects in ways that would be impossible with two-dimensional renderings: walking through, looking around, grasping, dragging, and throwing. I will report on a case-study where learners explored the shearing of a pyramid in a virtual-reality environment and used perspectives within and outside the pyramid to make arguments about the properties of the shearing transformation that would not be practicable with rigid three-dimensional or digital two-dimensional representations. This case-study analyzes how the affordances of immersive virtual reality environments might be used to explore geometry concepts in novel ways. By attending to affordances, we can consider what other technologies could support similar representations and where immersive virtual-reality environments have the most potential in school classrooms.

308. One-Week Curriculum for Grades 3-6 on Diversity and Inclusion Employing the Use of Kindness

Submission Category: Education

Author(s): Mila Long-Frost

Faculty Mentor: Lois-Ann Kuntz

Abstract:
This project outlines a comprehensive one-week educational curriculum addressing topics surrounding diversity, inclusion, and prejudice; emphasizing on the employment of kindness and empathy. The overall goal of the project is to help increase connection and acceptance of people with different identities, beliefs, and cultures within the school system. Topics such as prejudice, race, and diversity can prove difficult to address; making an educational avenue in the form of lesson plans an excellent place to start (Bregmam, 2019). Through research and resources from PBS Kids, TEDX discussions, and first-person documentaries, a compilation of information and resources was used to create a comprehensive five-day lesson plan surrounding topics of diversity and inclusion, empowering the use of kindness within our communities and society. The lessons are appropriate for grades three through six and sectioned into five one-hour blocks in order to keep the age group engaged, active, and enjoying the educational experience. By normalizing complex conversation around diversity and inclusion in adult educators, one can provide an education that arms children with the ability to make a positive impact surrounding the topics from an earlier age. The lesson plan project emerged upon being tasked in a course with demonstrating knowledge covering the reduction of prejudice/increasing support for people in marginalized groups. Encouraging school age children to employ kindness in learning, and interacting with diversity and inclusion through the form of a lesson plan, works to create a generation that embraces topics of diversity and their importance.

309. Augmented Reality Gardens

Submission Category: Education

Author(s): Claudio van Dujin

Faculty Mentor: Jon Ippolito

Abstract:
My goal is to create an app that uses augmented reality to allow users to design gardens in their backyards. The user will be able to view their yard through the phone's camera, and place plants, garden beds, and other equipment through augmented reality. The plants will be specifically chosen based on the user's climate and environment. Once a plant or garden feature is placed the user can order that plant or feature through the app and have it delivered directly to their home. The plants and garden features are ordered from local nurseries and establishments. The app will instruct users on how to plant the garden, and will provide live updates on maintenance, for example watering schedules based on climate and live weather conditions. The app will be your personal assistant in planning, planting, and maintaining your garden. The current design will focus on outdoor yards, however future iterations of the app would allow users to design gardens

for urban rooftop areas, balconies, indoor spaces, and more. Ideally, this application will allow anyone to start growing their own food, while also providing a way to get outside for individuals and families.

310. A Recommitment to Peer-to-Peer Contact Through Teacher Supervision and Support

Submission Category: Education

Author(s):
- Jason Kash
- Kelsey Stoyanova

Faculty Mentor: Ian Mette

Abstract:
Educators have long claimed teachers are experts in best instructional practices (Wolkenhauer & Hooser, 2017), but teacher evaluation systems don't allow for teachers to share that expertise (Zepeda, 2018). While supervision and evaluation are supposed to complement each other, our research has found teachers are unable to find the value in supervision because access and accountability to supervisory practice is not consistent (Mette et al., 2020), and their contact with one another is limited.

Through staff surveys and interviews, as well as research on best practices in peer coaching and teacher delivered development, our qualitative study found that while schools and districts value and include collegiality expectations, opportunities exist to further nurture and prioritize contact among teachers. Our research also showed teachers crave professional time and opportunity with peers, viewing them as vital support structures. The changes and rigors of operating our school during the pandemic also lend support to this method, as training from flipped classrooms to technology use has been developed at the grassroots level and delivered by teachers.

Our completed program evaluation informed our next action steps that pilot new models of peer-to-peer contact and collegiality including: restructured staff meetings that prioritize teacher sharing, teacher developed professional growth experiences, and a structure that allows teachers to observe one another and follow that time together with discussion. While the data are not generalizable, benefits of redefining teachers as supervisory experts include growing investment, boosting school culture, encouraging lifelong learning, and increasing student achievement.

311. Middle School Science Teachers' Experiences of Vulnerability in a Professional Learning Community

Submission Category: Education

Author(s): Eliza Jacobs

Faculty Mentor: Elizabeth Hufnagel

Abstract:
Teachers work in a highly social field and by interacting with each other make sense of their individual and community experiences, which are inherently intertwined with emotions. Yet, there remains a large gap in research-based understanding of teachers' experiences with vulnerability. The concept of vulnerability is approached here as a subset of emotions and also a way by which teachers expose their emotions in social situations. This project addresses how 15 middle school science teachers express vulnerability in their written reflection journals as a part of a year-long professional learning community. By determining what counts as expressions of vulnerability and addressing their contextual and interactional nature within the written discourse, this analysis makes salient the ways in which these expressions affect the professional learning community and its members. The patterns and themes in the expressions, as well as the implications for studying vulnerability of teachers in professional learning communities will be discussed.

312. Social Justice Through Social Media

Submission Category: Education

Author(s):

- Mikayla Palmer
- Moriah Weitman

Faculty Mentor: Rebecca Buchanan

Abstract:
The invention of social media has radically changed how people interact. Issues regarding social justice and equity appear in the news more often, and therefore are more likely to spark conversations on these online platforms. This study attempted to find connections between the topics that preservice teachers interact with online, platforms used, and the manner in which they participate. For this study, an online survey was distributed to undergraduate students in

education who attend the University of Maine. Participants were asked if they interacted with social justice on social media, and those who responded yes were given another set of questions to determine which topics they interact with, as well as how. Follow up interviews were conducted with select participants. Primary data on social media engagement was also collected for participants who were interviewed. The results indicated that racial justice, gender inequality, and LGBTQ+ rights were the issues most frequently engaged with on social media platforms; these results were consistent with what select participants liked and followed on their social media accounts. In addition, the most popular platforms were Instagram, Facebook and YouTube. Most respondents read and watched content related to these issues; very few created their own content. These results suggest that participants were more likely to engage with topics that had a personal impact on them. The survey noted that students were more likely to interact with these issues on Instagram, and the interview found that this was due to the characteristics of their followers on each platform.

Allied Health

Projects 401 - 425

Allied Health

401. Changes in School Nurse Perception of Adopting Bleeding Control Curriculum

Submission Category: Allied Health

Author(s): Megan Gallant

Faculty Mentor: Patricia Poirier

Abstract:
Context and Objective. During mass casualty events or trauma, the single most important factor to victim survival is the rapid identification and control of life-threatening bleeding. While many schools across the country have mandated the adoption of bleeding control curriculum for staff, some schools in southeastern Connecticut have not incorporated this training into annual staff education. Will school nurses in the Ledyard, Connecticut school district be willing to include this training for staff in the interest of improving response to trauma and mass casualty events?
Methods. School nurses were provided a 2-hour training session using the Stop the Bleed curriculum. Following the training, all nurses were eligible to register as Stop the Bleed instructors. Nurses were provided pre- and post-training surveys to determine knowledge level and attitudes toward adoption of the curriculum into annual school trainings. Nurses will receive an additional survey a week post-training to determine the percentage of nurses who completed the Stop the Bleed Instructor Registration.
Results and Conclusion. Nurses surveyed showed improvement in knowledge related to both the skills necessary to identify and stop life-threatening bleeding and the process of adopting and incorporating the curriculum into the annual staff trainings required by the Connecticut State Department of Education. At the 1-week point, trained nurses will be contacted to determine the number of participants who completed the registration process.

402. Screening Women for Late-Life Depression: The Primary Care Family Nurse Practitioner's Role

Submission Category: Allied Health

Author(s): Elissa Tremblay

Faculty Mentor: Eileen Owen-Williams

Abstract:
Depression is the most common mental health condition treated by primary care providers in the United States (U.S.). Maine is one of the states with the highest prevalence of depression for adult women. Over 479,800 women in Maine (35.7%) report a depression diagnosis compared to the 24% national average. The yearly U.S. economic burden of major depression is estimated to be greater than $210.5 billion. If undetected in the older woman, depression later in life has been shown to have serious consequences on quality of life, medical outcomes, health care utilization, morbidity, and mortality. Risk factors for depression include a prior depressive episode, being female, a family history of depression, childhood trauma, lower income, stressful life events, poor social support, medical comorbidities, dementia, substance use disorder, advancing age, residing in a rural area, and living alone. Screening for depression in older women in primary care has been shown to be effective in connecting women to treatment and improving quality of life. The CDC and USPSTF recommend screening as routine primary care with use of the PHQ-2 tool for screening and the PHQ-9 as appropriate. The Family Nurse Practitioner (FNP) is in a prime position to screen for and effectively treat older women suffering from depression. More than 80% of patients with a depression diagnosis can successfully be treated making it crucial for the FNP to screen all older women for depression in the primary care setting utilizing a standardized method and begin timely intervention.

403. Does Providing Education Reduce Vaccine Hesitancy?

Submission Category: Allied Health

Author(s):
- Stephanie Massey
- Kyle D. Massey

Faculty Mentor: Patricia Poirier

Abstract:
Background: The pace of COVID-19 vaccine development has been rapid. Significant public interest and the modern speed of information has created the paradoxical potential for under-informing and misinforming. Providing education from local experts may improve public perceptions and decrease vaccine hesitancy Method: This is a retrospective analysis of prospectively gathered anonymous survey data obtained before and after receipt of vaccine education as part of quality improvement. Due to software limitations, results were not paired. The survey employed six questions to assess three domains assessing: overall understanding, and understanding of safety, efficacy, mechanism of action, and side effects; and willingness to receive the vaccine. Responses were on a 5-point Likert scale and a free text comment was

allowed. The primary outcome was impact of education on willingness to receive the vaccine. Likert scale results were summarized using descriptive statistics. A two-tailed Student's t-test with an alpha-level set to 0.05 was used to test significance. Free text comments were grouped into relevant categories at the author's discretion. Results: For the primary outcome, median scores at baseline were 5(IQR 4,5). No significant difference in survey responses were noted (-0.06, 95% CI[-0.41,0.30]). For secondary outcomes median scores at baseline were 3 (IQR 3,4) and similar across questions. Scores increased significantly after education (0.95, 95% CI[0.84,1.07]) Conclusion: Willingness to receive the COVID-19 vaccine was high at baseline, and education did not make a significant impact on survey results, but improved vaccine understanding.

404. Developing a Level II Neonatal Intensive Care Unit (NICU) Nurse Orientation

Submission Category: Allied Health

Author(s): Erin Voisine

Faculty Mentor: Patricia Poirier

Abstract:
Level II Neonatal Intensive Care Unit (NICU) nurses provide skillful and dynamic postnatal care to neonates needing resuscitation and stabilization, as well as ongoing supportive care to neonates ≥32 weeks gestation and weighing ≥ 1500 grams who remain physiologically stable. To develop the knowledge, skills, and attitudes (KSAs) required to provide this care, a multilayered educational approach utilizing active learning strategies to increase critical thinking and clinical judgment is required. Ultimately, this will improve nurse competency, resulting in optimal, consistent, and evidence-based care to this vulnerable population. The identification of the KSAs that a Level II nurse must possess creates the foundation for this Level II NICU orientation. Topics within those KSAs have been developed into learning modules that include summaries and supplemental modalities such as policy reviews. Each learning module concludes with an exercise, such as an unfolding case study or multiple choice quiz, to develop critical thinking and clinical judgment using evidence-based strategies, such as priority setting, recognizing abnormals, or identifying risk factors. The literature supports the use of an organized, multilayered, and adult learner focused approach in the development of an orientation program. In addition, literature calls for facilitating lifelong learning in the nursing profession. To support the healthcare facility's need to formalize the orientation to provide dynamic postnatal care in the Level II NICU, a robust competency based orientation was developed.

405. An Assessment of Stress in Undergraduate Nursing Students

Submission Category: Allied Health

Author(s): Amy Barnes

Faculty Mentor: Patricia Poirier

Abstract:
Nursing students are enrolled in a rigorous curriculum involving didactic, lab and clinical courses. NUR 202 students are concurrently enrolled in their first Med/Surg lab and clinical rotation. This initial combination of course work can be overwhelming and cause increased stress. The mental health of students is a vital component to a successful nursing program.
The purpose of this study is to measure and understand the level of personal stress that second semester undergraduate nursing students are currently experiencing in their laboratory course (NUR 202). They will be asked to participate in a voluntary, anonymous survey via Qualtrics about their own perceived stress. The Perceived Stress Scale (PSS) consists of ten items that will measure how students perceive their reaction to situations over the last month.
Nursing students acknowledge that feeling incompetent and lack of professional nursing skills and knowledge, exposure to clinical practice, and heavy academic workloads are the origins of depression and anxiety. The negative effects of depression, anxiety and stress demonstrate the importance of treating their incidence among nursing students.
Survey responses will be reviewed and data will be evaluated to establish a baseline level of stress. Nursing students can not avoid the multiple stressors associated with their clinical coursework and must utilize coping strategies to successfully manage their stress levels. Faculty will be able to use survey data to identify needs and implement interventions to improve support of the nursing students' mental health throughout their progression in the nursing program.

406. Implementation of a S.K.I.N. Response Team as a Multidisciplinary Approach to Pressure Injury Care and Prevention

Submission Category: Allied Health

Author(s): Shannon Jagger

Faculty Mentor: Patricia Poirier

Abstract:
Hospital acquired pressure injuries (HAPIs) are on the list of serious reportable events (SRE) otherwise known as ‘never events’ according to the National Quality Forum (2021). Nevertheless, more than 2.5 million people develop HAPIs in the United States every year with 60,000 dying from associated complications (Agency for Healthcare Research and Quality, 2014). Like pressure injury rates across the nation, HAPI rates at the hospital involved in this study were at an alarming level. S.K.I.N. Response Team was developed and trialed on two (2) units with the highest HAPI rates within the organization. This team consists of the bedside nurse, nurse leader, provider, risk management, nutrition, wound nurse, clinical informaticists, and executive leader. The response brings the multidisciplinary team to the bedside within 20 minutes to assist with identification, interventions, and care planning for any identified skin concern. After a 90-day trial period S.K.I.N. Response went live across all in-patient units as a permanent fixture within the organization.
Through this work we have identified and targeted specific areas for improvement, uncovered opportunities within our electronic medical record, involve the patient and family in pressure injury prevention, developed relationships among the multidisciplinary team, decreasing cost of care to the patient, increased productivity, and seen a reduction in HAPI rates from 33 sentinel events quarter one of FY 2020 to 7 sentinel events quarter one of FY 2021 – a reduction of over 75%. This approach to pressure injury prevention served as the catalyst for a culture change around skin care and pressure injury prevention within the organization.

407. In Women of Childbearing Age with Cervical Ectopy (Cervical Erosion), How Does Cryotherapy Compared to Vaccination Affect the Incidence of Human Papillomavirus (HPV)?

Submission Category: Allied Health

Author(s):
- Elena Kolesnikova
- Emilienne Soucy
- Kaylin Le
- Madison Bibbo

Faculty Mentor: Valerie Herbert

Abstract:
Purpose: Cervical ectopy is a physiological process commonly found in women of reproductive age. The endocervical columnar mucosal layer everts towards the outside of the cervix. Cervical ectopy can be symptomatic (pelvic pain, bleeding, or vaginal discharge) or asymptomatic

(silent). Additionally, this condition has a strong significance in the prognosis of Human Papillomavirus (HPV). Cervical cancer is the second most common cancer in women worldwide, and HPV is the main causative agent and is detected in 99% of cervical cancers. The traditional prophylactic intervention for HPV in the United States is immunization. Cryotherapy has been shown to be effective in the treatment of symptomatic cervical ectopy in other countries and can serve as a preventive measure for HPV as well. The purpose of this literature review was to compare the effectiveness of these two interventions on the incidence of HPV in women of childbearing age with cervical ectopy.
Method: PubMed and CINAHL databases were searched for any scholarly articles related to the topic and published between 2010 and 2021. The following keywords were used: cervical ectopy, cervical ectropion, cervical erosion, cervical eversion; HPV, Human Papillomavirus; vaccination, immunization; cryotherapy, cryocauterization, and cold therapy. Out of 25 relevant articles found, 14 matched the criteria.
Conclusion: Upon review of the literature, the implementation of cryotherapy and vaccination can help reduce the incidence of HPV. Further research is needed to evaluate which method of prevention would be most effective in women with cervical ectopy.

408. Statin Use and Dementia Incidence

Submission Category: Allied Health

Author(s): Mariana Day

Faculty Mentor: Eva Quirion

Abstract:
There is a positive correlation between dementia and high cholesterol in midlife individuals, which has been indicated through research. In the analysis, it is stated that even though there is a possibility that statins could potentially prevent dementia, there are some safety concerns regarding the adverse effects of statins (Zhang et al., 2018).
Purpose: This aims to clarify the effects of statins with relation to dementia and whether statins can prevent or reverse the disease (Flodgren & Berg, 2016). Due to safety concerns for users of statin medication, this will also clarify whether statins could lead to dementia (Zhang et al., 2018).
Data Sources: Information was acquired from a review of literature from 2008 to 2019.
Conclusion: Clinical trials show that prolonged statin usage in patients who have Alzheimer's Disease (AD) does not change the disease's pathology. Midlife dyslipidemia seems to play an essential role in the development of AD. Studies continue to show mixed results; however, the highest-quality studies display that statins have a protective effect in preventing dementia if

taken during midlife. Based on the abovementioned research, memory loss and confusion are associated with statin use within one or multiple years from beginning treatment. However, statins were not associated with dementia or even with significant cognitive decline, and the symptoms tend to resolve once the medications were discontinued. The providers need to take into consideration the patient's benefits as compared to associated risks and apply shared decision making before the medication is discontinued.

409. Communication with Patients on End of Life

Submission Category: Allied Health

Author(s): Danielle Fabian

Faculty Mentor: Patricia Poirier

Abstract:
Life expectancy is increasing along with rates of chronic disease due to advancements in therapies. These advancements to prolong life, necessitate the need for early end of life (EOL) discussions, starting with advanced care planning. Early discussions with patients, lead to better patient satisfaction, better quality of life, and less stress for the family.
Purpose: This paper will discuss the patient and provider barriers to approaching EOL discussion along with facilitators that improve communication. Other topics discussed will be how EOL care is evolving and the nursing implications on EOL.
Data Base: Information was obtained through a review of literature between 2016 through 2020. Data bases used were CINAHL, Google Scholar, and OneSearch.
Conclusion: Improved patient outcomes and satisfaction in the context of end of life (EOL) care, is having early discussions. Literature shows that introducing advanced care planning in a timely manner allows the patient and family time to process and plan for their last wishes. Barriers are identified on both the patient side and provider side for advanced care planning.
Implications for Practice: Literature shows a lack of formal education in medical training on advanced care planning and how to effectively communicate with patients on EOL discussions. Incorporating advanced care planning and EOL discussions within school curriculum could predictably prepare providers to feel better prepared. Continuing education within employment will help maintain skills in communicating difficult material to patients and their families.

410. The Effects of COVID-19 in the Treatment of Opioid Use Disorder

Submission Category: Allied Health

Author(s):
- Claire Collins
- Ashley Oullette
- Abigail Danforth
- Jane Stevens
- Valerie Herbert

Faculty Mentor: Valerie Herbert

Abstract:
Background and Focus
The US has been experiencing an opioid epidemic over the past decade, that has "continued to surge substantially, realizing 300–400% increases among some populations" (Cochran et al., 2020). Our focus was, in adult patients with opioid use disorder (OUD), how has the treatment availability been affected by COVID-19, compared to treatment availability prior to the pandemic? The pandemic has drastically increased the demand for remote care models involved in the access to medications for OUD.

Methods
Information was collected using the CINAHL database, PubMed database and Google Scholar. We searched these databases for evidence based practice articles related to OUD and treatment availability, before and after the COVID-19 pandemic. Keywords used in our search included: OUD, treatment availability, and COVID-19 pandemic. A total of 773 articles were found and 12 were used.

Outcomes of the Project
After review of the literature, certain interventions such as prescribing patients more take-home medication, shortening medication refill windows, or eliminating the need for face-to-face refill requirements, may increase treatment availability to pre-pandemic levels for OUD patients. The literature also recommends that in addition to psychiatrists being able to prescribe these treatments, pharmacists should be able to as well. Lastly, it is recommended to initiate peer-to-peer and telehealth meetings to prevent overdoses. Interventions should be implemented in various healthcare facilities and out-patient clinical settings which can minimize the impact of decreased in-person care.

411. Effect of Remote Mental Health Services on Anxiety and Depression Rates During the COVID-19 Pandemic

Submission Category: Allied Health

Author(s):
- Stephanie Nichols
- Jennifer Turner
- Miranda McKim

Faculty Mentor: Valerie Herbert

Abstract:
Focus
The COVID-19 Pandemic has created isolation, fear, and stress on a global scale. This tumultuous environment has left devastating effects on mental health, specifically anxiety, depression, and insomnia. Additionally, safety and distancing guidelines have greatly limited the access to in person mental health treatment. The purpose of this literature review is to analyze the benefits of remote mental health services and determine if these services decrease rates of anxiety, depression, and stress disorders in adults when compared to in-person services during the COVID-19 pandemic.
Methods
The databases consulted for this literature review were PubMed and CINAHL. The search was conducted using the following keywords: 'COVID-19', 'pandemic', 'disaster management', 'emergency', 'emotional distress', 'mental health', 'depression', 'telehealth', and 'telemedicine'. A total of 22 articles were examined for usability and 13 articles were incorporated into this literature review.
Outcomes
The literature has shown that the COVID-19 pandemic has led to significantly increased rates of anxiety, depression, and stress disorders. The literature also points to the efficacy of telehealth in managing mental health disorders. After review of the literature, it is evident that telehealth services are a viable solution for the reduction of anxiety, depression, and stress disorders among adults affected by the COVID-19 pandemic.

412. The Effects of Nurse Patient Ratios on Geriatric Patient Outcomes

Submission Category: Allied Health

Author(s):
- Deanna Kolenovic
- Emma Moulton
- Taylor Jackson
- Victoria Shepardson

Faculty Mentor: Valerie Herbert

Abstract:

PICO Question

In hospitalized geriatric patients (age 65 and older), how do higher nurse to patient ratios compared to lower nurse to patient ratios affect patient outcomes in the last five years?

Topic and Purpose

The level of patient safety and outcomes accomplished depends on the quality of care provided. This study examines how nurse staffing contributes to patient outcomes among hospitalized geriatric patients. The purpose of this study is to identify potential areas of improvement for patient safety and outcomes.

Methods

The researchers examined the CINAHL Database on the University of Maine's Fogler Library website using keywords including nurse-to-patient ratio, geriatric patient outcomes, quality indicators, nurse staffing, and adverse effects. We used all evidenced based and peer reviewed articles published within the last 10 years for our research. Twelve evidence based, peer reviewed articles published within the last ten years were found. The researchers organized data into a table to analyze patient outcomes related to nurse-to-patient ratios.

Conclusion

Upon review of the literature, increasing nurse patient ratios may positively impact patient outcomes in hospitalized geriatric patients. The data suggests increasing nurse patient ratios should be implemented in all hospital units with geriatric patient populations. This intervention should decrease mortality, shock, medication errors, ulcers, restraint use, unplanned extubation, patient falls,infections, pneumonia and patient length of stay. Further research is required to determine recommendations for optimal nurse patient ratios on geriatric units.

413. A Quality Improvement Approach to Reducing Hospital Readmission Rates in Heart Failure Patients

Submission Category: Allied Health

Author(s):

- Anna Cressey
- Natalia Budri
- Eliza Palow
- Reilley Joyce

Faculty Mentor: Valerie Herbert

Abstract:
PICO Question:

In heart failure patients over 50, would implementing discharge education, interdisciplinary collaboration and medication management lead to improved treatment outcomes and decreased readmission rates within 30 days?

Topic and Purpose:

Heart failure is a leading cause for readmission in elderly patients, leading to increased healthcare costs, patient mortality and decreased quality of life. Hospital readmissions related to heart failure are associated with a lack of interprofessional collaboration, non-compliance to treatment regimens, and knowledge deficits regarding the disease process. The purpose of this review is to identify interventions to reduce 30-day readmission rates of patients with heart failure.

Methods:

Using the CINHAL database on the University of Maine Fogler library website, fifteen articles were initially found regarding heart failure readmissions, the impact on health outcomes and different interventions that can be used to decrease readmission rates. Key words such as heart failure, readmissions, teach-back method, interdisciplinary collaboration and medication management were utilized. Ten articles were used to research the PICO question. Evidence-based and peer reviewed articles published within the last five years were used.

Outcomes:

Upon review of the literature, several effective interventions were identified. These included using the teach-back method during patient education, collaborating with other healthcare team members and individualized patient care. These resulted in improved patient satisfaction, improved health outcomes and reduced readmission rates. The outcomes will be put into a table and further analyzed. These interventions should be implemented during the initial admission within the interdisciplinary care team. Further analysis will be needed to determine the most effective interventions in specific populations

414. The Effect of Group Activities on Cognitive Decline in Those Diagnosed with Dementia

Submission Category: Allied Health

Author(s):
- Hannah Nadeau
- Gabbi Kaczynski
- Katie Swanson
- Megan Sobiech

Faculty Mentor: Valerie Herbert

Abstract:
PICO
In elderly patients with dementia, how does participating in group activities compared to not participating in group activities affect the decline in cognitive functioning within one year?

Background
Over 50 million people worldwide have been diagnosed with dementia. The purpose of this study was to determine the importance of and if participation in activities such as listening to music, or exercising, could affect the cognitive decline of those with dementia.

Methods
We conducted a literature review using peer reviewed studies from CINAHL and Google Scholar databases that had been published within the last 5 years. A total of 16 articles were found, but only 12 studies were used. Through using the key words dementia, cognitive decline, and group activities, our research team narrowed the search to include studies looking specifically at the impact of group activities on cognitive decline.

Outcomes
Group activities do not conclusively delay the cognitive decline of elderly adults with dementia. These activities did have a significant impact on quality of life. This being that group activities such as exercise helped clients meet their intellectual, social and emotional needs, while also helping prevent physical decline and serious events such as falls. Lastly, the research found that older adults who had consistent intellectual, social, and emotional stimulation decreased their risk for a diagnosis of dementia later in life. Further research is still needed to determine what activities increase quality of life in those with dementia, and what frequency of activities can help prevent cognitive decline.

415. Benefits of Female External Urinary Catheters

Submission Category: Allied Health

Author(s):
- Mary Chamberlin
- Andrea Bresnahan
- James Cramer
- Sierra Harmon

Faculty Mentor: Valerie Herbert

Abstract:
Topic/Purpose
Catheter associated urinary tract infections (CAUTI) are the leading cause of healthcare associated infection in the United States. It is essential to consider ways to reduce these infections as many patients require some form of bladder drainage during their hospital stay. The purpose of this review is to examine whether female external urinary catheters (FEUCs), a non invasive alternative to indwelling bladder catheters, reduce rates of infection and skin breakdown in these patients.
Methods and Results
Using CINAHL and other scholarly databases connected to the University of Maine System, ten evidence-based, peer-reviewed articles related to the efficacy of various catheter types were selected from approximately 15 relevant articles, and subsequently studied. The articles, published within the last five years, were related to evidence-based practice and care. Articles were found using search phrases such as: “external catheter efficacy,” “harm reduction with FEUCs,” and “benefits and risks associated with external/indwelling catheters.” The conclusion of the study and information regarding indwelling catheters versus FEUCs were summarized.
Conclusion
After reviewing the literature, the study concluded that the incidence of CAUTIs decreases with the use of FEUCs. Decreased CAUTI rates were especially high in intensive care units. FEUCs also prevent skin breakdown. FEUCs should become part of the protocol for decreasing infections and skin breakdown obtained in hospital settings. More research is needed to develop best practices for incorporating these devices into everyday use.

416. Effects of Volunteering on the Health of Older Adults in a Caregiving Role

Submission Category: Allied Health

Author(s):
- Rachel Coleman
- Jennifer Crittenden

Faculty Mentor: Jennifer Crittenden

Abstract:
Caregiving for a dependent and increases in age are both associated with declines in health and wellbeing, though this may be mitigated through the physical and mental health benefits associated with volunteer participation. To explore the impact of volunteer involvement on the health of those who are both older adult caregivers and volunteers, demographic and activity data from a longitudinal sample of caregivers aged 55 and older from the National Survey on Caregivers (NSOC) was analysed to identify significant health changes for those who were not volunteering in round II (2015) and then began volunteering in round III (2017) (n=56). NSOC is supplemental to the National Health and Aging Trends Study (NHATS) survey of people who are 65 or older and receive Medicare benefits.

Caregivers' general health was provided through self-assessment on a Likert scale of 5 (excellent) to 1 (poor). A paired t-test revealed significant correlations between round II (m=3.52) and round III (m=3.57) caregiver self-reported general health but no significant difference between means. Base weights provided by NSOC were then applied to the data (round II N=534,149, round III N=867,614). An unpaired two-tailed t-test of this weighted data revealed a statistically significant difference ($p<0.0001$) between the round II mean general health score of 3.51 (SD=1.011) and the round III mean general health score of 3.56 (SD=1.024), indicating that volunteer participation for the month prior to assessment improved general health self-assessment.

417. Frontline Nursing Leadership Program

Submission Category: Allied Health

Author(s):
- Sarah Hanscome
- Lori Fiandaca

Faculty Mentor: Patricia Poirier

Abstract:
The Future of Nursing: Leading Change, Advancing Health recommends that nurses should be prepared and enabled to lead change to advance healthcare in the United States. Often time, frontline nurses are placed in leadership positions without the proper training to meet the evolving healthcare system challenges. Providing thorough educational training to frontline nurses is key to providing patient-centered care that is based on safe practices, regulatory guidelines, and professional standards of practice. An electronic search of the literature was conducted using the following keywords: Frontline leader, charge nurse, and leadership skills. The literature supported the use of formalized training to improve nurses' knowledge, skills, abilities, and attitudes in an array of leadership competencies. However, the literature showed a lack of formalized leadership training and education for frontline nursing leaders around the country. Due to the evolving and increasingly complex healthcare system, the need for formalized Frontline Nursing Leadership Programs is critical for providing safe and efficient care. With the support of hospital administration, a year-long leadership program will be developed for frontline leaders. The initial part of the project requires curriculum development and nurse leader approval. Once approved, the education will be provided monthly. An evaluation will be done pre-and post-program using a five-point Likert Scale. The evaluations will be compared to assess for improvement and program success. The goal of the Frontline Nurse Leader Program is for nurses to acquire skills that will improve their practice, knowledge, and confidence in an array of leadership skills.

418. Program Profile Project: How RSVPs Support Older Adult Volunteers Who are Working and Caregiving

Submission Category: Allied Health

Author(s): Abbie Hartford

Faculty Mentor: Jennifer Crittenden

Abstract:
Older adults are a key group of volunteers for the nonprofit sector and research by the Corporation for National and Community Service (CNCS) in 2015 revealed more than 21 million older adults volunteered over 3.3 billion hours of service in their communities. Despite this, the rate of formal volunteering is decreasing as rates of participation in other roles are increasing. Recruiting and retaining volunteers is a complex task with a variety of supports tailored to volunteer needs in order to ensure ongoing volunteer participation. With such complexities further research is needed to better support volunteer organizations and their volunteers as they seek to recruit and support volunteers over the long-term.

The Retired and Senior Volunteer Program (RSVP) is a national program that trains and places older adult volunteers. This Phase 3 of a multi-phase study focusing on older adult volunteers examined strategies RSVP sites have implemented that support volunteers who are holding multiple life roles such as working and/or caregiving.

This poster presentation will review findings from semi-structured qualitative interviews conducted with eleven RSVP sites across the United States. Participating RSVPs ranged in size from 50 volunteers to 650 volunteers. Interview analysis revealed six main category themes including onboarding practices that are sensitive to the needs of older workers and caregivers and offering one-time and flexible volunteer opportunities. This presentation will examine all six thematic categories. This research will culminate in the creation of a program that will instruct other volunteer programs in implementing similar best practices to better support volunteers.

419. Healing the Cycle of Intergenerational Trauma: The Family Nurse Practitioner's Role

Submission Category: Allied Health

Author(s): Jessica Alicea-Santiago

Faculty Mentor: Patricia Poirier

Abstract:
The Family Nurse Practitioner provides care to individuals across the lifespan including members of families--often the entire family--with exposure to Adverse Childhood Experiences (ACEs). With the rising prevalence of ACEs since original research was conducted over two decades ago, current literature is calling for increased screening of ACEs in primary care, transforming delivery of care to a trauma-informed approach, and--ideally--primary prevention of trauma. An intergenerational cycle of abuse is common and includes physical, emotional, and sexual abuse; physical and emotional neglect; witnessing domestic violence; having a family member with mental illness, substance abuse, or incarceration; and losing a parent due to separation or divorce. Increased exposure to ACEs increases risk of cognitive-social-emotional dysfunction which leads to risk for chronic disease and premature mortality. Attention to the prevalence and implications of ACEs is further magnified by the concurrent phenomenon of America’s rapidly aging population. Aging, itself, is a risk factor for accruing lifetime trauma and is implicated in challenging end of life experiences. Further research is needed to examine the implications of providing end of life care to one’s parents in the setting of ACE exposure and intergenerational trauma. Review of the literature reveals the extensive scope of ACE impact, challenges of the aging population in regards to caregiving, and the role of the Family Nurse Practitioner in trauma prevention strategies, universal screening practices, implementation of

trauma informed care, and incorporating intergenerational storytelling to promote resilience and empowerment of the entire family throughout the life continuum.

420. Rural Disparities for the Elderly

Submission Category: Allied Health

Author(s): Dana Lyon

Faculty Mentor: Eva Quirion

Abstract:
Caring for people over the age of sixty-five is a daily and expected service for primary care providers, such as nurse practitioners. In the state of Maine, approximately 20.6% of the population is over the age of sixty-five, which is the highest percentage in the entire United States of America. This review focuses on the difficulties that those over sixty-five face such as transportation problems, lack of caregiver support, food insecurity, and decreased access to specialty care. Databases utilized during the search included CINAHL (73 results), Google Scholar (82,100 results), and PubMed (406 results). Key search words include rural disparities in health care, rural elderly health, treatment, health disparities, chronic medical conditions, primary care in rural communities, and programs to help elderly. Only articles that where peer reviewed, scholarly articles, published in 2015-2020, and in the English language were reviewed. There was limited literature to support the review in the United States of America, as most articles were posted regarding studies from Asian countries, such as China, Japan, and Taiwan. The literature upon the review conducted supported that there are deficits of heath care for those over sixty-five years old, especially in rural areas. The articles and websites in this paper support that there are problems with transportation, food security, caregiver support, and specialty clinics and services.

421. Making Aging in Place Possible for Maine Seniors

Submission Category: Allied Health

Author(s): Briann Andrews

Faculty Mentor: Kelley Strout

Abstract:
This paper is a systematic review of literature about the population shift that is occurring worldwide with the potential implications it has on the future care for older adults and their ability to “age in place” in Maine. There were a total of 23 sources included in this review. The period of time covered in the review ranged from 2008-2021. Maine is the oldest state in the nation per capita of the total population. Advancing age results in functional changes that can affect a person’s ability to provide proper care for themselves. A large proportion of adults are wishing to age in the community, and they desire to stay within their homes. When early identification and interventions are implemented, Family Nurse Practitioners (FNP) are in a position to develop and assist in the execution of a comprehensive and coordinated plan while developing a close provider-patient relationship to help preserve the individual’s ability to age in place without having to enter a care facility. The FNP can use a comprehensive geriatric assessment to identify functional needs and potential deficits in care; they can also have conversations at the beginning of their relationship to identify the patient’s goals of care. They can assist in the collaboration of other professions, like occupational therapy, to make recommendations for necessary home adjustments to ensure safety and success while staying in their home and community as they age. Long-term care placement in Maine has limited capacity and has had documented negative psychological effects on individuals. Many make every attempt to avoid this placement and with the early intervention facilitated by the FNP, there is a greater chance of people successfully aging in place.

422. Hypertension in Rural Haiti Screening, Treatment, and Management

Submission Category: Allied Health

Author(s): Joseph Morse

Faculty Mentor: Eileen Owen-Williams

Abstract:
Elevated blood pressure, known as hypertension (HTN) is recognized globally as the leading cause of premature death and disability in all populations. Hypertension is associated with an increased rate of a brain stroke, kidney failure, and heart disease including heart failure and coronary artery disease. By 2025, the worldwide prevalence of HTN is estimated to affect 1.56 billion people. Developing countries disproportionately are affected by chronic disease such as hypertension at greater rates. In Haiti, hypertension is the leading cause of morbidity and mortality among adults, greater than Human Immunodeficiency Virus (HIV), cholera, tuberculosis, or malaria combined. Two thirds of Haitians over 40 years old have hypertension, and rural Haitians are at a higher risk for complications due to lack of appropriate screening and

sustainable medical care. Treatment for hypertension in the Haitian rural setting is limited due to multiple barriers to care. A collaborative model of culturally sensitive care that has been effective includes Community Healthcare Workers (CHW), Haitian volunteers, volunteer medical teams, Haitian medical teams, and most importantly, the hypertensive patient working together in the treatment of hypertension. Rural villages are identified as having a need for a hypertension screening clinic with the input of all team members, patients are then screened for elevated blood pressure, and patients newly diagnosed with hypertension receive anti hypertensive oral medicinal therapy. This paper will examine hypertension in rural Haiti elucidating important historical events that have led to current socioeconomic disparities and describe issues related to the diagnosis and management of hypertension.

423. Early Home Visiting Programs: A Key Component of Maternal and Infant Health in Maine

Submission Category: Allied Health

Author(s): Rebecca Bolduc

Faculty Mentor: Patricia Poirier

Abstract:
Early home visiting (EHV) programs have received widespread support from healthcare providers and policy makers as an effective public health approach to improving the perinatal health of moms and babies. Recent literature supports that EHV programs improve birth outcomes, prevent and reduce child abuse and neglect, improve family relationships, advance school readiness, reduce preventable diseases, and ultimately reduce healthcare costs. The Center for Disease Control and Prevention supports that these resources available to families in the perinatal period directly correlates with the rise and fall in infant mortality rate. Maine utilizes three early home visiting programs: Maine Families, Public Health Nursing, and Early Head Start. These programs are state and federally funded, some serve target populations and some are universally offered. However, despite steady efforts to provide early home visiting services across the state, only a small percentage of families are served. Knowledge gleaned from the literature and expert interviews helps identify some of the barriers to program expansion in Maine. Possibly the most common barrier identified is the lack of program awareness by health providers. Nurse practitioners play a pivotal role in overcoming this barrier. As one of the fasting growing careers in the nation and as a profession that practices in a diverse array of healthcare settings, Maine nurse practitioners should be knowledgeable of the programs available, advocate for policy change, and make the referral when appropriate. Ultimately, more families would have home visitation and maternal and infant health in Maine would unquestionably improve.

424. Education and Nursing Interventions of the Spinal for Injury Patient

Submission Category: Allied Health

Author(s): Amanda Cowan

Faculty Mentor: Patricia Poirier

Abstract:
Focus:
Educating nursing staff on the various clinical responsibilities required in the holistic care of a spinal cord injury (SCI) is immense. It requires the nurse to be thoroughly educated, and in turn, well equipped for critically thinking regarding all aspects of bodily functions of the individual SCI patient.
Method or Process:
A systematic approach of evidence based literature, combined with an immersion experience of acute, intermediate, and chronic care of the SCI patients, is the foundation of the education being presented. A visual poster presentation, verbal explanation and printed educational handouts will be given to the audience and an informal Q&A will be allotted.
Outcomes of the Project:
In every stage of the SCI progression, there are key educational objectives that require correlated nursing inventions that are pertinent in the continuum of care. Dedicated education focused on each stage of SCI progression will contribute to increased patient outcomes and long term quality of living.

425. Motivations and Experiences of Older Adult Volunteers: An Exploration of a Telehealth Simulation Experience

Submission Category: Allied Health

Author(s): Kayla Thompson

Faculty Mentor: Jennifer Crittenden

Abstract:
This presentation will explore Retired Senior and Volunteer Program (RSVP) participants' experiences and motivations in regard to recruitment and participation in a telehealth nursing simulation. The UMaine School of Nursing partnered with the RSVP program to engage older adult volunteers as mock patients in a telehealth simulation training for nurse practitioner

students. Volunteers were offered pre-simulation training to prepare for their role play assignment. The study encompasses three debriefing interviews following each volunteer's participation in the virtual simulation. Following the debriefing interviews, transcripts were created and reviewed for accuracy. Transcripts were coded for recurring themes to determine the motivations and experiences regarding the participants' volunteer simulation. Initial findings of the qualitative analysis determined that previous educational and volunteer experiences or personal experiences with healthcare were strong motivators to sign up for the simulation. Additionally, having an existing connection with the university was noted by volunteers. Other positive motivators identified include feeling helpful in teaching students. Volunteers reported an ease with the use of Zoom and noted that the telehealth platform facilitated their ability to engage in the role play s, citing being able to discreetly use "cheat sheets" and personalize the script. Lastly, volunteers identified that thorough training was essential to a positive role play experience. This summary presentation represents feedback gathered from debriefing interviews. It is anticipated that findings will accumulate over time to further solidify themes and guide future research efforts.

426. Older Adult Nutrition Innovation Pilot: Partner Interviews

Submission Category: Allied Health

Author(s): Jennifer Jain

Faculty Mentor: David Wihry

Abstract:
In-home supports and proper nutrition are critical to post-acute recovery and long-term health management for adults 60 and older. Such supports are often difficult to deploy in rural settings. To address these challenges, a unique multi-sector consortium was formed between a local Area Agency on Aging, a healthcare system, a health technology company, and the University of Maine's Center on Aging to conduct a clinical trial of a novel in-home health technology program paired with customized chronic care nutrition support. Early stage clinical trial development required coordination across health and community-based organizations to develop a pathway for older adults to access the in-home project supports. At the conclusion of the year one, six project partners were interviewed using a semi-structured interview protocol examining the strengths of early project design and challenges inherent in the early phases of a community-based clinical trial. Thematic analysis uncovered six themes instructive in formulating efficacious clinical trial methodologies: 1) Logistical challenges related to the pandemic, including reduced patient numbers and the curtailing of in-hospital recruitment; 2) Partner collaboration as essential to designing preferred project modifications; 3) The challenge

of converting project referrals into project enrollees; 4)A new appreciation among community partners regarding institutional review board requirements; 5) Recommendations for addressing emerging staffing challenges; and 6) The overriding importance of engaging older adults in their own care and health promotion post-discharge. Results will inform construction of a replicable model for establishing novel research partnerships that span healthcare, social services, the business sector, and higher education.

427. Operationalizing Person-centered Care in Long Term Care Settings: Initial Literature Review Findings

Submission Category: Allied Health

Author(s): Rocky Coastlines

Faculty Mentor: Jennifer Crittenden

Abstract:
Person centered care has been recognized as the gold standard in healthcare (Kitwood, 1998) for decades. But what exactly is person-centered care, what does it entail, and how can it be operationalized for long term care settings? At the University of Maine Center on Aging, the Mayer-Rothschild Designation of Excellence in Person-Centered Care Project has set out to explore this question in partnership with The Cedars, a person-centered retirement community in Portland, Maine. In this presentation, I will describe the first month of work completed on the project's literature review and its initial findings. Through using the US Preventative Services literature review methodology, a database of relevant articles was compiled through searches using two different sets of inclusion/exclusion criteria: one for definitions of person centered care generally, and another specific to person-centered care in long term care settings. From the 152 academic articles compiled, 14 domains of person centered care as they relate to long term care were identified. We organized these into 4 overarching categories (me and my wishes and feelings; my family, friends, and community; my personal space and spared spaces; and my care providers) and applied ecosystem theory (micro, mezzo, and macro) and the Donabelian model (structure, process, outcome) to the compiled definitions and domains. The literature review team then engaged in free association as a research method (Randolph, 2015) to look at gaps in the existing literature and brainstorm new possible domains (justice and racial inequity, risk-taking, identity, and social isolation and loneliness). We have been able to apply these initial literature review research findings to inform the development of a survey, message board activity, and focus group, which will further contribute to creating a designation for person-centered care in long term care settings.

Engineering and Information Sciences

Projects 501 - 556

Engineering and Information Sciences

501. Production of Renewable Fuels from Biomass-Derived TDO Oil

Submission Category: Engineering and Information Sciences

Author(s):
- Matthew Kline
- Sampath A. Karunarathne
- M. Clayton Wheeler

Faculty Mentor: M. Clayton Wheeler

Abstract:
As governments around the world place more restrictions on the production of energy from fossil fuels, the demand for fuels from renewable sources is projected to increase. One of the most promising materials to convert into bio-oil is cellulose, which is advantageous because residue from logging, farming, or even municipal waste are sufficient feedstocks. Several pathways have been developed to convert cellulose into bio-oil, one of them being Thermal DeOxygenation (TDO), which shows promise. It is a process developed at the University of Maine that converts organic acids from cellulose hydrolysis and dehydration into a low-oxygen bio-oil with a broad boiling point distribution.

While the chemical compounds in TDO oil could be directly used to produce gasoline, they lack some of the characteristics of petroleum middle distillates, such as jet fuel and diesel. In order to replace these fuels, TDO oil must be upgraded using catalytic hydrogenation and ring opening steps.

This presentation discusses the chemistry and reactions required to produce renewable gasoline, diesel, and jet fuels for commercial use. Past, present, and future work on upgrading TDO oil will be discussed, as these extra steps are integral in producing an array of transportation fuels. The presentation will also discuss my current research focused on the hydrogenation and ring opening of bicyclic molecules to produce fuels with better diesel combustion characteristics.

502. Professorly

Submission Category: Engineering and Information Sciences

Author(s):
- John Baker
- Ryan Matthew LaMarche

Faculty Mentor: Jon Ippolito

Abstract:
From the perspective of a student, getting to connect with teachers was one of my favorite parts about in person learning. No matter the college, subject, or course, every single one of my teachers had awesome experiences that I was happy to hear about. My project was created with the goal to reignite the connection between professors and students that is often absent from online learning. This platform would allow professors to create personalized profiles that display things like interesting research experiences, photos, hobbies, or anything else they think would be useful to future/current students to learn about them. We also want students to be able to discover new classes that fit their interests that they normally never would have, by searching for keywords/categories. Finally, we want to add a review system that improves on something like RateMyProfessor.com, by promoting positivity and encouraging constructive feedback. One very useful scenario we saw our platform being used would be during syllabus week, where there often is no homework except for students to pour over a pdf of the course structure. Professors could bring a lot of life to their syllabus and create a connection with students by including a link to their profile in their syllabus. We plan on adapting to professor and student feedback as we iterate our project, but we are very happy with what we've already created so far.

503. Thermoplastics 3D Printing Using Fused Deposition Modeling on Fabrics

Submission Category: Engineering and Information Sciences

Author(s):
- Maxwell Blais
- Scott Tomlinson
- Bashir Khoda

Faculty Mentor: Bashir Khoda

Abstract:
The creation of large objects by additive manufacturing is something that is desired, but often is unachievable due to the size of the object and capacity of the 3D printer used. Beside additive manufacturing multifaceted single objects will produce a non-homogeneous performance in the object due to directional anisotropic of additive manufacturing process. To address this issue

research has be done are part segmentation with various techniques, such as origami, geometric segmentation, and segmentation with manufacturability. However, joining or connecting those segmented or discretized additive manufactured parts can become an issue. Mechanical fasteners, glue, interlocking parts, or hybrid technique are commonly suggested for connecting multiple smaller parts to create a large object. Issues with these methods are that they take additional time and may add some additional weight and be cumbersome to transport and assembly.
In this paper we propose to use fabric as a flexible joint and segment carrier when creating larger objects by additive manufacturing. Specifically, segmented parts of the desired large object will be additive manufactured on top of a fabric as to adhere the two. To do this, first we apply a segmentation algorithm to discretize a large object considering manufacturability, mechanical isotropy, weight, fabrication time, and printing envelope. Once segmented a machine-readable file is constructed suitable for open source 3D printer. Treated and untreated fabrics are prepared simultaneously so that parts could be created on top of them. Segments are created and adhesion force between the segment and the fabrics are tested with Instron adhesion tests. We found that untreated cotton duck cloth had an average 78% higher adhesion than other samples with the applied polymeric material, PLA plastic, from additive manufacturing a part on the samples. We also found that bed and nozzle temperature and distance between fabric and nozzle during printing played a significant role in the measured adhesion force. Adhesion forces desired between fabric and 3D printed part could be tailored as needed per specific large object as needed using this information.

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Approved for Public Release –DEVCOM SC PAO U1-357

504. Electrical Power System for CubeSats

Submission Category: Engineering and Information Sciences

Author(s): Joseph Patton

Faculty Mentor: Ali Abedi

Abstract:
MESAT1 is a CubeSat that was proposed by the University of Maine in response to NASA's CubeSat Launch Initiative, and was selected by NASA to fly aboard a NASA rocket in 2022.

One of the most important factors in prolonging the lifetime of a CubeSat satellite is the design and testing of the electrical power subsystem (EPS). The EPS is a microprocessor-based device that tracks and controls power generation and distribution for all subsystems and payloads of the spacecraft. This study covers the design, building, and testing of a low-cost EPS system that will safely and efficiently power the MESAT1 for the entire duration of the mission.

505. Joining Methods for Continuous Fiber Reinforced Thermoplastic Composites in Structural Applications

Submission Category: Engineering and Information Sciences

Author(s): Andrew Moran

Faculty Mentor: Roberto Lopez-Anido

Abstract:
The potential of joining methods for continuous fiber reinforced thermoplastic (CFRTP) composites in structural applications is investigated. The joining methods considered are: adhesive bonding, secondary forming and mechanical fasteners. Carbon fiber-Polyphenylene sulfide (PPS), a type of engineered thermoplastic, unidirectional composite tape was selected to consolidate plates with quasi-isotropic layups. Both composite-composite and aluminum-composite joints were examined using experimental lap shear evaluations. The experiments serve to characterize the mechanical properties required for structural design using the proposed joining methods: adhesive bonding strength, secondary forming interlaminar strength and fastener bearing strength. In addition, a comprehensive program of standard tests for material characterization of the CFRTP composite selected were conducted to generate properties for structural analysis. A structural model of a connection in a structure was developed using finite element analysis. The experimental findings on joining methods, and recommendations on design optimization of connections with CFRTP composites are discussed.

506. Magnetorquer Design for Small Satellites

Submission Category: Engineering and Information Sciences

Author(s):

- Travis Russell
- Ashanthi Maxworth

Faculty Mentor: Ali Abedi

Abstract:
Cube satellites, or CubeSats, are small satellites that are commonly developed and used by universities and private companies to carry out scientific missions in Low Earth Orbit (LEO). These satellites include various subsystems that work together harmoniously to ensure the success of a mission. One such subsystem is called the Attitude Determination and Control System (ADCS), which is responsible for sensing and maintaining a desired orientation of the satellite while it is in orbit. It is often the case that both the radio communications system and the success of the science mission depend on proper orientation, making the reliability and fidelity of this subsystem of utmost importance. This research covers the design and testing of low cost magnetic actuators, called magnetorquers, which can control the orientation of a CubeSat by their interaction with Earth's magnetic field.

507. Operation and Preliminary Energy Balance of a Portable Kelp Dryer in Maine

Submission Category: Engineering and Information Sciences

Author(s): Tuqa Al-Asadi

Faculty Mentor: G. Peter van Walsum

Abstract:
Seaweeds are important commodities as food or raw material for additives and biopolymers. One popular species native to the Maine coast is Sugar kelp. It is a brown alga, rich in fiber, minerals, and antioxidants. Seaweeds are highly perishable due to their high moisture content and will spoil quickly if not preserved, therefore a common practice is to dry the product to prolong storage life and to minimize the cost for transportation. A drying method using warm air will extend seaweed shelf life and retain many of the valuable bioactive components that are heat sensitive. Thus, a controlled drying environment can best retain product value and prevent degradation. A prototype commercial scale dryer, housed in a portable 40' shipping container, was developed to provide this environment. My research is focusing on examining the drying rate, temperature and humidity, and energy efficiency of the process. Experiments were run using wet towels or Sugar kelp in the dryer. Examination of the drying runs shows that as air passes through the drying chamber it decreases in temperature and gains humidity but does not reach saturation.
The temperature of the internal air was affected by the degree of air recycle and furnace activity. Simultaneously, as the drying progressed the exiting air showed a steady trend of rising temperature and decreasing RH. Analysis of the run data suggest that improving interior air ducting and insulating the walls of the container (except on bright sunny days) will likely be cost effective.

508. Search and Rescue Sled Suite

Submission Category: Engineering and Information Sciences

Author(s):
- Jesse Bosdell
- Liza White
- Caroline Bray

Faculty Mentor: David Neivandt

Abstract:
Existing rescue sleds lack the equipment necessary to assess and treat patients while communicating with first responders during transport. There have been some minor improvements to existing sleds to protect the patient and provider from the weather, however, current solutions inhibit the ability to treat the patient. The purpose of the current project is to modernize the existing, commonly used rescue sled to allow providers to assess and easily treat the patient while also being able to communicate with outside agencies to further enhance the overall patient outcome. In order to accomplish the project objectives, subsystems were created to target patient care, comfort, and communication. Specifically, a vital sign monitoring system was designed to allow the providers to access and track trends in the patient's health. Additionally, a suspension harness system was created to reduce patient vibration and impact transmission during sled movement; the suspension system incorporated heating elements to greatly improve patient comfort. Finally, headphones and a microphone were added to the existing Motorola communication system to allow for safe and effective transmission of patient condition and location. Once the subsystems were created, the entire unit was tested to validate patient safety, effectiveness, and functionality. Future tests will assess the safety for the medical provider, the capabilities of the communication system, and the effectiveness of the hardware and software that is under development to facilitate the automated uploading of patient vital signs to an online database. The work to data has demonstrated that existing rescue sleds can be modernized to greatly improve patient care, communication, and ultimately, patient medical outcomes.

509. Investigation of Bioaerosol Catch-and-Release Dynamics via Liquid Net Filtration

Submission Category: Engineering and Information Sciences

Author(s):
- Dan Regan

- Junie Fong
- Justin Hardcastle
- Caitlin Howell

Faculty Mentor: Caitlin Howell

Abstract:
Materials and methods of collecting bioaerosol for performing analysis on potential biological threats is at an all-time high after over a year of battling COVID-19. Currently, filter-based air samplers capture the highest yield and ratio, while liquid impingers offer the best chance to maintain pathogen viability. In this body of work, we present a novel approach to filter-based filtration by fabricating liquid nets. Infusing polytetrafluoroethylene filters with a perfluoropolyether oil resulted in improved rate of release of captured Escherichia coli aerosols onto culture plates. Furthermore, wetting meltblown polypropylene filters with the same perfluoropolyether oil improved the rate of release, as well as the overall colonies transferred and cultured. The efficiency of bioaerosol transfer demonstrated by the liquid-infused filters could provide a better representation of the airborne pathogens within an environment, enabling informed actions by infectious disease experts and medical professionals.

510. Finite Element Analysis of Glucose Diffusivity in Peripheral Nerve Conduits

Submission Category: Engineering and Information Sciences

Author(s): Nicklaus Carter

Faculty Mentor: David Neivandt

Abstract:
Peripheral neuropathy is estimated to afflict 20 million people in the United States. Most cases of neuropathy result from physical injuries and trauma arising from automobile accidents and war. Peripheral nerves have the intrinsic ability to regenerate over time, bridging the injury gap resulting from trauma. Current methods utilized to assist in the regeneration of peripheral nerves include nerve grafts and neural conduits. Nerve autografts are regarded as the most effective method but require a second surgical site to access a donor nerve or a nerve donation from another individual. Current available conduits have equal or lower success rates relative to nerve grafts with specific issues including immune response and stability insufficiencies. It has been proposed that a biocompatible material such as cellulose nanofiber may serve as a viable alternative conduit material. Preliminary studies have shown that cellulose nanofiber conduits are successful in aiding neural regeneration and further, that conduit length has an impact on efficacy

in murine models; it is hypothesized that the length dependence may be related to modified diffusion distances of key cellular nutrients and waste metabolites. The present work investigates the concentration profile of a key nutrient, glucose, within the conduit. A finite element analysis of the conduit system has been established using COMSOL Multiphysics. Variations in the physical dimensions of the conduit were investigated to determine the impact on glucose concentration profiles. The resultant information is being used to aid in the development of improved conduit designs to optimize functional recovery of peripheral nerve injuries.

511. Dynamic Visualization of Past and Future Forest Change Within the Maine Forest Ecosystem Status and Trends Web Application

Submission Category: Engineering and Information Sciences

Author(s):
- Scott Audet
- Eric Schessler
- Ethan Esber
- Devin Merrow
- Dominic Pacelli

Faculty Mentor: Kasey Legaard

Abstract:
The Lorax are among a handful of computer science capstone software development teams for the 2020 - 2021 academic year. Our team consists of Scott Audet, Ethan Esber, Devin Merrow, Eric Schessler and Domonic Pacelli. For our project, we elected to work on a web application to support the Center for Research on Sustainable Forests, led by UM faculty Kasey Legaard and Erin Simons-Legaard. The application is titled the Maine Forest Ecosystem Status and Trends (ForEST) App.

The ForEST App is an online web mapping application that allows users to monitor the spruce budworm outbreak tracking out of Canada into Maine. Within the application, users can view current measures from budworm trap sites and maps of vulnerable forest resources across the state. This vital information is provided to Maine’s foresters and forest stakeholders to help mitigate the effects of the outbreak and to protect the state's natural resources. Our team has been tasked to expand upon the existing web application in order to improve the delivery of information to its users.

The purpose of a capstone project in computer science is to expose students to professional software development practices. Our team has learned to deliver high quality software in a remote environment using continuous integration techniques such as agile development. The team plans to complete testing and deliver the enhanced application toolset by the conclusion of the semester. These tools will allow users to obtain greater information on the outbreak, including predictive models displaying future impact on Maine's forests. The Lorax hope this suite of features will improve upon Kasey and Erin's efforts and benefit future users of the ForEST App.

512. Precision Actuator for Small Scale Robotics

Submission Category: Engineering and Information Sciences

Author(s): Patrick Murphy

Faculty Mentor: Bashir Khoda

Abstract:
Recent developments have made robotics more affordable, like the >$500 actuator developed at MIT. However most robotic actuators are inaccessible to individuals due to the still relatively high cost. In this work, fused deposition modeling 3D printing along with inexpensive brushless dc motors are studied to determine the viability of such methods for the creation of a precision small scale robotic actuator. There is little information about the use of fused deposition modeling for drive components.To overcome the limitations in using such a manufacturing method the gear reduction utilizes a cycloidal gear drive, known for it's low backlash and compact size. The profile of such a gear is modeled as a parametric curve. Inexpensive 'hobby' garde brushless dc motors offer high efficiency and torque density, but operate at higher rpm requiring gear reduction . Initially a 300Kv 42mm by 20mm motor was selected. The open-source, closed-loop brushless dc driver known as ODirve was utilized.
Following development and simulation of 5 'path-finding', collective findings were put into the design of Prototype 1. This is the first interaction that had the intention of being built and tested. Motion studies and static load simulations showed the design should perform within expectations, maintaining a safety factor >2. Upon review of these findings Prototype 1 was prepped for testing. The cycloid drive performed as designed when driven by hand. During preliminary testing and setup it was noted that the motor was running hot. While current was limited to 50% the motor underwent a thermal event while trying to reach 500rpm. This resulted in the motor burning out and the deformation of the surrounding plastic fused deposition modeling parts. This led to a major redesign Prototype 2, with a larger motor with a 260% increase in rated current. The assembly was designed to be easily fabricated with a desktop 3d

printer and is expected to deliver precise control of motion. Total cost for the actuator is under $120 which can be a great option for the diy community as the design will be open source and available for download form various repositories. In future, a study on the friction coefficient between FDM parts would need to be performed before such a motion study, to ensure high fidelity of the time consuming operation. Contingent on the outcome of experimental static load testing, further research into improving the fidelity of FDM CAD models is also proposed.

513. High Shear, High Residence Time Drying of Cellulose Nanofibrils

Submission Category: Engineering and Information Sciences

Author(s):
- Brandon Dixon
- Amos Cline

Faculty Mentor: David Neivandt

Abstract:
Cellulose nanofibrils (CNFs) are biomass materials on the nanoscopic scale derived from wood. CNFs are hydrophilic and are typically produced as aqueous slurries. The CNF slurry can be employed in its aqueous form or dried in two- and three-dimensional forms for a variety of applications. The structure of UMaine produced CNF is highly hierarchical with interconnected branches of decreasing size ranging from macroscopic diameter pulp fibers, down to nanoscale diameter fibrils. Upon conventional drying of CNF hydrogen bonding between the fibers and fibrils results in a very large degree of aggregation, and concomitant loss of the nanoscale elements of the material. Supercritical drying employing a solvent change and use of carbon dioxide is capable of drying CNF without aggregation, however it is a challenging technique to scale up. Similarly, spray drying limits the CNF aggregation to create micron scale beads that may have some utility, but again scale up is problematic. The goal for the current work is to create a novel, efficient, and cost-effective method of rapidly drying and separating CNF into individual fibril forms. Work to date has employed high shear generated from a rotor and stator system, coupled with gaseous over-pressurization and release, and modest heating to provide energy and separation force to dry CNF while minimizing fiber aggregation. Prototypes constructed thus far have shown promise, but have indicated that higher shear and longer residence times in the rotor/stator are likely required. The dried CNF powder will be incorporated into wood polymer composites for large-scale 3D printing.

514. Do Virtual Flavors Influence Liking and Emotions?

Submission Category: Engineering and Information Sciences

Author(s): Meetha Nesam James

Faculty Mentor: Nimesha Ranasinghe

Abstract:
Flavors of food and beverages are closely associated with a lot of our daily activities. Food researchers have worked on altering the chemical formula and composition, calorie configuration, and the ingredients list of the food to enhance the sensory liking and preference of the food being consumed. By altering those features, we lose the real experience of the food along with possible health side effects. Hence, the challenge is to simulate these sensory experiences without altering food chemically. The concept of Virtual Flavors refers to sensory stimuli that are stimulated externally without chemically or physically altering the food but by digitally augmenting it with the help of three distinct modalities: electric stimuli for taste, aroma dispersion for the smell, light stimuli for color, thermal stimuli for heat and cold perceptions. However, little is known about the influence of various sensory modalities such as taste, smell, color, and thermal towards perceiving simulated flavor sensations and people's emotions, liking, and pleasure.
To evaluate this white space, we present 1) an interactive technology to simulate different flavor sensations by overlaying taste, smell, color, and thermal sensations on plain water externally, and 2) a set of experiments to investigate a) the influence of different sensory modalities on the perception and liking of virtual flavors and b) varying emotions mediated through virtual flavor sensations. Our findings reveal that the participants perceived and liked various stimuli configurations and mostly associated them with positive emotions while highlighting important avenues for future research.

515. Techno-Economics and Life Cycle Analysis of a Biofuel Blend-stock Process

Submission Category: Engineering and Information Sciences

Author(s):

- Aysan Najd Mazhar
- Thomas Schwartz
- Sampath Reddy Gunukula

Faculty Mentor: M. Clayton Wheeler

Abstract:
The most significant sources of energy for many countries are fossil fuels and their derivatives. Due to environmental impacts of these nonrenewable fuels, finding substitutes for them are of high interest. Fast pyrolysis process has the potential to offer high efficiencies to produce liquid transportation fuels. This process is considered as a direct thermochemical procedure that can liquefy solid biomass into liquid fuels such as gasoline and diesel blend-stocks. The process includes rapid heating of biomass particles in the absence of air at approximately 500°C with the production of non-condensable gases, bio-oil or pyrolysis oil, and char. The pyrolysis oil can be upgraded via integrated mild hydrogenation and etherification processes to a high energy density fuel that can be blended with diesel for transportation use.
In this study, a process model to upgrade low energy density forest residues to a high energy density fuel using integrated fast pyrolysis, mild hydrogenation, and etherification processes will be created. The ASPEN plus simulation is used to determine the material and energy balances of process model. Thermodynamic properties of the hydrogenation and etherification model compounds were estimated by using Density Functional Theory (DFT). The feedstock (sawdust) processing capacity of 2000 dry metric ton per day and capacity factor of 0.9 were assumed for process simulations. The process equipment is sized using the simulated material and energy balances. The discounted cash flow analysis with an internal rate of return of 10% is selected to assess the minimum selling price of high energy density fuel. The life cycle analysis (LCA) has been conducted to assess environmental sustainability for producing a renewable high energy density fuel. The ASPEN simulations have shown that the hydrogen requirements of the mild hydrogenation of bio-oil is met through the steam reforming of non-condensable gases of fast pyrolysis. The amount of high energy density fuel produced is 54 million gallons per year and the assessed minimum selling price is $2.63 per diesel gallon equivalent. The LCA well-to-wheels analysis, performed using Argonne's GREET 2019 software, indicates that the renewable diesel blend-stock would have a 92% reduction in fossil fuel use and a 93% reduction in greenhouse gas emissions relative to petroleum diesel.

516. A Birefringence Semantic Segmentation of Muscular dystrophy in Zebrafish Using Deep Neural Networks

Submission Category: Engineering and Information Sciences

Author(s): Ahmed Almaghasilah

Faculty Mentor: Clarissa Henry

Abstract:
In any typical lab that studies the molecular level of zebrafish, such as investigating the integrity of the dystrophin glycoprotein complex and its impact on muscle health and development, it can generate over hundreds of Birefringence images on a monthly basis. Manual segmentation of muscle segments, called myotomes, is a tedious task, full of errors and biases. In addition, it demands collaborators to be familiar with the software tools, as well as the anatomy of the zebrafish - which can be significantly hard to distinguish especially when the muscle fibers sustain a severe muscle degeneration. The severe muscle degeneration tends to obscure collaborators' judgment and increase the error rates, because the myotendinous cannot be phenotypically observed. Deeplab v3+ network, a convolutional neural network (CNN) designed for semantic image segmentation, with a pre-trained ResNet-50 architecture delivers consistent and superior segmentation outcomes. The CNN makes a prediction of muscle segments with 95% accuracy, compared to the manual segmentation annotated by various collaborators. The CNN classifies each individual pixel and renders a fully segmented overlay of a Birefringence image in less than a minute. The prediction produced by the deep neural network accelerates the process of quantification, analysis and validation streamline of wet-lab experiments faster than before.

517. Tuning CNF Fibril Orientation for Tissue Integration Applications

Submission Category: Engineering and Information Sciences

Author(s):
- Josh Hamilton
- Sahar Roozbahani
- Omar Alsamsam
- Michael Mason

Faculty Mentor: Karissa Tilbury

Abstract:
Internal injuries can require multiple surgeries creating extra risk for the patient and increasing recovery times. Absorbable scaffolds for wound repair may mitigate the need for multiple surgeries, however, there is a lack of low-cost solutions in the market that meet high force applications. A readily produced fibril material at the University of Maine known as cellulose nanofibers (CNF) fulfills both the mechanical and biological properties required for high force applications such as bone fixation devices. The purpose of this work is to develop a methodology to tune and quantity CNF mechanical properties thereby mimicking different tissue environments for future tissue integration applications. To do this, a novel orientation strategy using a constant

unilateral force on CNF films drying on a flexible substrate was developed. Changing the force applied allows adjustment of CNF anisotropy which directly affects its mechanical properties. A quantification methodology was also implemented using the natural birefringence of CNF. An orientation index based off film birefringence was used to quantify CNF. Maximum applied force films had a birefringence orientation index (BOI) that was 80% higher than non-force applied films. Another imaging tool is needed to resolve individual fibers and determine if the BOI is a viable tool for elucidating fiber orientation. To accomplish this, SEM images of both force dried, and non-force dried films were taken, and fiber orientations in these images were analyzed using a FIJI plugin called OrientationJ. This determined the BOI is an effective and readily available tool to determine CNF fiber orientation.

518. Design and Manufacturing of Printing Head for Aligning Short Fibers

Submission Category: Engineering and Information Sciences

Author(s):
- Miao Hu
- Akhter Zia

Faculty Mentor: Yingchao Yang

Abstract:
3D printing has been widely adopted to manufacture a broad of composites. If feed materials are polymer, particles or 1D fibers, individuals can be with any orientations after landing on the print bed. The obtained composites will be isotropic. For the fiber reinforced composites, generally, the fibers are expected to be aligned in order to maximumly inherit the mechanical performance of the fibers. However, the commercial printer is unable to print fibers with controlled alignment but random distribution only to date. Our project aims at combining the shear force theory with the 3D printing head to constrain fibers to parallel each other. The project includes three major tasks. (1) The printing head will be fabricated with rifling which is inspired by the rifle barrel imparting spin to the projectile along the longitudinal axis to stabilize projectile flight; (2) Regarding that the rifling is very challenging to be fabricated inside of the printing head, we plan to cut the printing head into halves and use laser to sculpture the designed refiling; and (3) A stationary aligner will be designed to have all fibers align along certain direction when the fibers come out from the printing head. Before fabrication of the printing head, the Solidworks software will be used to design a set of rifling modals and apply 3D printer to print the rifling. The printing head will be then used to print short carbon fibers, where the alignment of the fibers will be evaluated by an optical microscope and scanning electron microscope. If necessary, the

length, pitches, depths, shape of the rifling will be updated depending on the alignment of the printed fibers.

519. Characterization of electrically-conductive filament for FDM 3D-Printing

Submission Category: Engineering and Information Sciences

Author(s): Mackenzie Ladd

Faculty Mentor: Brett Ellis

Abstract:
With the recent introduction of electrically-conductive filaments for fused depositional modeling (FDM), many new avenues have opened for novel design methodologies and processes. An example of such a filament is the ProtoPasta Conductive PLA, which is a polylactic acid polymer substrate infused with conductive carbon black particles, thus imbuing conductivity. The biggest barrier for more widespread use of this new material is a lack of characterization. This research seeks to address this problem by characterizing an electrically-conductive filament and comparing empirical results with manufacturer-produced data and the limited amount of data available in literature. The effects of raster patterns and number of layers were determined via 20 × 20 mm2 cross-section conductive-filament cubes having heights of 3, 5, 7.5, and 10 mm. Resistances were measured in the build direction, in the build plane parallel to raster direction, and at 45° to the build direction. All specimens included divots – either 1-mm-wide by 0.4 mm-deep as-printed divots or as-printed then post processed via a soldering iron divots – to locate multimeter probe tips. This research will facilitate the optimization of 3D-printed designs to achieve preferred material properties. Additionally, such data will enable new design methodologies, including, but not limited to implementing conductive segments within compliant mechanisms, thus adding even more capabilities to compliant mechanisms' enhanced wear characteristics and reduced manufacturing costs.

520. This Abstract Moved to Another Category

521. Flight Computer Design for Cube Satellites

Submission Category: Engineering and Information Sciences

Author(s): Steele Muchemore-Allen

Faculty Mentor: Ali Abedi

Abstract:
In any Cube satellite, or CubeSat, the center of operation is the on-board flight computer. This project covers the design and implementation of a microprocessor-based device to function as the flight computer and data handling unit for the MESAT-1, Maine's first Cubesat to be launched in 2022. The central flight processor monitors and maintains functionality of the CubeSat as a whole, ensuring each subsystem is operating as designed.
Another important function of the flight computer is to collect and manage data from various on-board sensors and the specific science payload. The flight computer will collect and sample data, and respond to any necessary subsystems accordingly. The aim of this research study is to develop a system that will allow the satellite to function properly for the entire duration of the mission.

522. Relay-Assisted Wireless Energy Transfer Scheduling with Dual Data-Energy Channel Models

Submission Category: Engineering and Information Sciences

Author(s): Sonia Naderi

Faculty Mentor: Ali Abedi

Abstract:
Relay energy assisted communication where a transmitter is powered by an energy source through both direct and relay links is considered in this project. Data transmission based on stochastic models for data and energy channels is considered. Various static, mobile and highly scattered channel models are studied to cover a wide array of applications where battery replacement is not feasible. A threshold on required transmission energy and channel quality to decide whether the transmission is beneficial or risky is derived for all possible scenarios. All theoretical results are validated by numerical simulations and verify the effectiveness of energy relaying and proposed energy efficient scheduling method in reducing the outage probability of the system.

523. Bioinspired Liquid-Infused Membranes Reduce Biofouling

Submission Category: Engineering and Information Sciences

Author(s):
- Justin Hardcastle
- Daniel Regan
- Junie Fong
- Jessica Schiffman
- Rushabh Shah

Faculty Mentor: Caitlin Howell

Abstract:
Polymer membranes that are widely used for water treatment and wastewater reuse are prone to fouling or the accumulation of particulates and bacteria. Fouling significantly reduces process productivity and additionally, to clean fouled membranes, a combination of physical and chemical processes are used that increase process downtime and degrade the membranes. The purpose of this work is to use surface science inspired by the pitcher plant to create a new approach to membrane design that will reduce the adhesion of particulates on membranes, providing a transformative new way to prevent membrane biofouling. First, we tested membranes with two different chemistries and pore structures, polytetrafluoroethylene (PTFE) and polyvinylidene fluoride (PVDF) for their ability to maintain a stable, continuous liquid coating of a perfluoropolyether fluorinated liquid (DuPont KrytoxTM). Specifically, we measured the continuity of the surface liquid layer by testing how easily a water droplet could begin moving on a surface and the anti-adhesion properties of the surface liquid layer through quantifying the speed of droplet movement at a static angle of inclination. The results indicate that the PTFE membranes could sustain a more consistent liquid layer, with an approximately 75% lower sliding angle and 70% faster droplet movement at a fixed angle than the PVDF. Qualitatively, the liquid coated PVDF membranes show signs of visual dewetting in air over time. Analyses also showed a difference in the quality of the liquid layer depending on the amount of residual water present in the membrane at the time of coating. Interestingly, dead-end pure water permeability (PWP) experiments conducted at an applied pressure of 1.5 bar indicated the liquid coated membranes had a statistically equivalent PWP of 2827 ± 323 L/m2-h-bar over 10 cycles. In static biofilm formation assays, infused PTFE reduced biofilm formation by approximately 98%, while liquid coated PVDF reduced bacterial attachment by approximately 25%. These results are the first steps toward a transformative new approach to prevent filtration membrane biofouling.

524. Solid Particles Transfer by Dipping From Heterogeneous Mixture

Submission Category: Engineering and Information Sciences

Author(s): S M Abu Naser Shovon

Faculty Mentor: Bashir Khoda

Abstract:
Dip coating, a wet deposition method is an effective and straightforward way of thin-film or layers formation. It is extensively used as a coating method due to its simplicity, low cost, and reasonable control over the thickness. In this work, the physical phenomenon of dip coating process with negatively buoyant, non-Brownian micro-particles from density mismatching mixture is investigated. The inorganic particles provide spherical geometry with an average diameter of 5.69 μm. A liquid carrier system (LCS) is prepared by a polymer-based glue and an evaporating solvent. The concentration of polymer glue was varied between 2.5% to 10.5%. The rheology of LCS shows a Newtonian characteristic throughout the shear rate ranging from 0.2 to 1000 s-1. Three different volume fractions (20%, 35% and 50%) of inorganic particles are added to LCS solution and a pseudo liquid carrier particle suspension is prepared by using a magnetic pellet moving at minimal suspending speed from 500 to 700 rpm. The cylindrical AISI 1006 mild steel wire substrate is dipped at different withdrawal velocity ranging from 0.01 mm/s to 20 mm/s.
Once the cylindrical substrate is extracted from the heterogeneous mixture, the coating thickness is measured in our lab. The average thickness as well as the surface packing coverage by the particles is increasing with higher volume fractions of particles in the mixture. Moreover, for same volume fraction of particles, the coating thickness is increasing with high polymer-glue concentration and for the substrate withdrawal speed. The coverage of inorganic particles in the coated substrate is measured at 20% to 35% at lower volume fractions. This coverage referred to the heterogeneous regime with low suspension viscosity, and cluster of particles covered randomly almost all the coated area which also follows closely with Landau-Levich-Derjaguin (LLD) law. In this regime the capillary number, Ca remains ≤ 3× 〖10〗^(-3). More inorganic particles are entrained in the substrate at volume fraction of 50%, and the thickness (>35 μm) becomes almost uniform through the entire coated area. This high-volume of particles is referred to the effective viscous regime with capillary number, Ca over 4× 〖10〗^(-3). The results present the influence of volume fraction and substrate withdrawal velocity on the solid transfer from the heterogeneous mixture. Solid transfer technology from mixtures is gaining ever-increasing attention from both materials scientists and production engineers due to their high potential in near net shape production of cost-effective engineering components. The result of this research may help understanding the high-volume solid transfer technique and develop a novel manufacturing process.

525. Developing Software for Aerial Imagery Handling and AI Analysis Management

Submission Category: Engineering and Information Sciences

Author(s):
- Devin Christianson
- Nick Kania
- Jacob Morin
- Alex Feren
- Kyle Walker

Faculty Mentor: Cynthia Loftin

Abstract:
The BirdSpotter web application is designed to integrate machine learning into the analysis workflow for estimating the population of nesting birds using aerial imagery. BirdSpotter is built for use by biologists, to allow rapid population measurement without the added overhead of manual categorization. It allows users of the app to view data on a map as well as in the aggregate, and also allows for the importing or exporting of processed datasets. To automatically categorize the behavior of nesting birds, the project uses a machine learning algorithm created by members of the University of Maine Graduate program. BirdSpotter is being developed using agile methods in a modified V development model, with frequent client involvement from initial requirements specification to prototyping and validation. We learned a lot during the initial design process, in trying to solve one of the most common dilemmas in software: how to design a system that meets the client's needs, without introducing unnecessary complexity or overhead. During development we had to overcome several unique challenges, such as handling large files, managing sensitive data, and interfacing effectively with external systems. Testing and validation was also a challenge when a system interfaces with other external systems, and has high performance requirements, but a comprehensive testing plan with a strong continuous integration and delivery pipeline helped keep this validation overhead lower.

526. MLA Survey Analyzer

Submission Category: Engineering and Information Sciences

Author(s):
- Benjamin Patashnik
- Alex Gay
- Mark Sullivan

- Jeremy Thiboutot

Faculty Mentor: Erin Vinson

Abstract:
Our project, the MLA Survey Analyzer, will be a tool designed to improve the Faculty Course Modification Incentive Grant – Maine Learning Assistant (FIG-MLA) program survey process at the University of Maine. Currently, surveys administered to students to track the progress of the FIG-MLA program are manually modified, sanitized, and analyzed by employees at the Maine Center for Research in STEM Education (RiSE Center) who have requested a software solution to automate the process and enhance the efficiency of survey analysis. The MLA Survey Analyzer will be able to quickly and automatically de-identify, organize, analyze, and store survey responses.
This project is being developed by four senior students enrolled in the Computer Science Major at the University of Maine. Team members are working with and deriving system requirements from a contact at the RiSE Center. Separate elements of the project have been assigned to different team members, such as database integration, data analysis, and user interaction. The team is developing the system using MySQL for database management and the Python programming language for program functionality and the user interface. Program development adheres to a mixture between an agile methodology and the V-model.
The expected outcome will consist of an executable program that will be accessed by the user. The user will be able to import new survey data into the database, or view data stored on the database. The program will automate the process of importing data from surveys, while simplifying the process used to sort and analyze data. Finally, the program will help generate reports for feedback used to improve the RiSE Center's FIG-MLA program.

527. Electrical Impedance Spectroscopy Based Food Recognition to Facilitate Food Journaling

Submission Category: Engineering and Information Sciences

Author(s): Chamath Lochana Amarasinghe Hiti Harmillage

Faculty Mentor: Nimesha Ranasinghe

Abstract:
The rate of chronic health conditions has increased over recent decades due to unhealthy food choices and diets high in processed sugar and sodium. At present, people are more concerned about their food intake and maintaining food journals to monitor their diet content. These food

journals help individuals self-manage chronic diseases and their primary care providers to understand eating habits and answer critical questions to make informed decisions. Some of these key questions are associated with the type of the food, quantity, and the time users are eating. Thus, recognizing the food and its internal attributes is necessary for automatic food journaling. As a solution, contemporary research focuses on recognizing food based on image processing, where AI algorithms analyze images to identify and record food items. However, current solutions are ineffective in identifying internal attributes (e.g., salt content) and quantifying food and beverages.
Our work's broad aim is to study the effectiveness of Electrical Impedance Spectroscopy (EIS) combined with AI algorithms to develop novel non-visual food and ingredient detection technologies to enable new possibilities in the domain of Human-Food Interaction. A smart mug that recognizes the liquid (i.e., a beverage), the sugar content of the liquid, and its volume were the initial study's centerpiece. It employs two stainless steel electrodes connected to an impedance analyzer to measure the liquid's impedance. A classifier that employs Support Vector Machines analyzes the impedance data to identify the liquid, while an Artificial Neural Network predicts the volume and sugar content.

528. Nanoparticles as Local Reporters in Biological Systems: Modeling Signal and Understanding Limitations

Submission Category: Engineering and Information Sciences

Author(s):
- Jeremy Grant
- Aimee Co

Faculty Mentor: Michael Mason

Abstract:
As early as 2001, advances in engineered nanotechnologies have caused great excitement about the possibility of using Raman active nanoparticles as inert, non-toxic, non-bleaching alternatives to fluorescent molecules and quantum dots. Coupled with improvements in microscopy and modern laser light sources, the apparent surface enhancement Raman effect (SERS), measured in several seminal studies, demonstrated that nanoprobes based on this approach exhibit effective cross-sections exceeding that of conventional fluorophores, thus implicating their use as image contrasting agents in biological systems. Now, nearly 20 years later, there exist few practical examples of the use of SERS active nanoprobes, despite significant levels of funding and many related publications. These previous works failed because they ubiquitously assumed near-optimal behavior in several key probe factors including Raman

cross-section (enhancement), nanoparticle surface loading (number of probe species present), and available nanoparticle concentration (number of particles), all of which are attributable to working in a complex, highly non-ideal biological environment. Here we present a simple accounting model which includes all relevant signal limiting parameters but is simplified to the level of the individual probe molecule, the enhancing nanoparticle, and the sample volume in which they are measured. This scalable model makes it possible to understand the signal limitations apparent in previous attempts at imaging these probes in biology and allows for a facile determination of likely signal limitations; a key consideration for planning future Raman based imaging experiments.

529. A Smart Wheelchair Cushion to Reduce the Incidence of Pressure Sores in Low-Mobility Populations

Submission Category: Engineering and Information Sciences

Author(s):
- David Flewelling
- Malak Helal
- Michael Gray

Faculty Mentor: Michael Mason

Abstract:
Pressure sores are a common issue for patients who spend extended periods on a wheelchair or lying down. Wheelchair cushions attempt to alleviate this problem by distributing pressure, but do not perform effectively for patients whose immobile periods are extended. This work aims to develop a reasonably cost-effective cushion replacement that distributes pressure to reduce or eliminate pressure sore formation. The proposed design incorporates a memory foam top and an air cushion with an adjustable and self-filling pressure system. The device also includes a smart electronic system which can automatically determine when the patient needs to self-adjust or be moved in the seat by an attendant. The entire device will be encased in a waterproof nylon case to maintain the cleanliness and usability of the device in the case of incontinent users, as well as to protect electronic components. Prototypes were assessed by the impact of the device on comfort, the frequency of self-adjustment by the user, and averaging user-reported comfort with the device. These results confirm that this device can measurably reduce the formation of pressure sores by decreasing the pressure exerted on tissues, and making it easier for medical attendants to recognize when a user needs care to prevent sore formation.

530. Binary Maze Game

Submission Category: Engineering and Information Sciences

Author(s):
- Ethan Mason
- Jeffrey Edrington

Faculty Mentor: Andrew Sheaff

Abstract:
This report describes the design of a microprocessor-based device that takes user input and to navigate a sixteen step maze was designed, built, and tested. The device features seven available inputs. One for turning the device on or off, one to reset the current state, one to change the level, and four to navigate the game. Initially all indicators are on and the goal is to turn the indicators all off. Each navigational input corresponds to an indicator. The user may only interact with the input if its current indicator is on. When an indicator in the on position is interacted with in this way the device changes to a state where the interacted indicator is off but the other indicators can change or not change depending on the predetermined maze. The users goal is to get the state of the device from the starting state of all indicators on to the final state of all indicators off.

531. Smart Tourniquet: A New Approach to Existing Technology

Submission Category: Engineering and Information Sciences

Author(s):
- Darren Hanscom
- Emily LeClair
- Tian Morrison
- Chris Toothaker
- Lisa Weeks

Faculty Mentor: Michael Mason

Abstract:
Tourniquets have been used for thousands of years with little change to their design and function; though the ability of tourniquets to save lives and limbs is undeniable, prolonged application leaves patients at risk for severe nerve and tissue damage. Further, they lack the ability to provide feedback to first responders regarding duration of application, heart rate, and pressure

applied to the limb. Therefore, the purpose of this design is to augment current tourniquet designs to include electronics capable of providing such information so emergency care providers can make more informed treatment decisions. To accomplish this, an inflatable tourniquet will be assembled and tested to validate its functions; the series of tests will ensure that the device has consistent ability to inflate and maintain applied pressure, stop blood flow, and store and send data via Wi-Fi, Bluetooth, and cable connection. Along with the ability to prevent limb loss, a successful design will fill gaps in current tourniquet functionality and safety, benefitting both patients and emergency care providers. A successful device will also be applicable in any emergency, including battlefield wounds, wilderness survival, and emergency clinical care.

Acknowledgments:
This work was supported by the Department of Biomedical Engineering at the University of Maine. The authors would like to thank Dr. Robert Bowie, Dr. Michael Mason, Dr. David Neivandt, Dr. Lisa Weeks, and Angela Hildreth for their advice and support throughout the duration of this project.

532. What Personal Information is Your App Collecting?

Submission Category: Engineering and Information Sciences

Author(s): Vijayanta Jain

Faculty Mentor: Sepideh Ghanavati

Abstract:
Developers must provide privacy notices to the users when their application collects, processes, or shares their personal information. However, creating concise and consistent privacy notices is a challenging task for developers. A recent survey found that there are ~2.89 inconsistencies between the privacy notices and the personal information processed in each Android application. Such violations under regulations such as the European General Data Protection Regulation and California's Consumer Privacy Act can lead to large fines up to millions of dollars for developers. To help them create consistent privacy notices, previous work has focused on creating notices through a questionnaire or predefined templates. Since developers may not be aware of all the personal information processed in their application, especially in third-party libraries, questionnaires can lead to inaccurate notices. Similarly, a notice template will lead to a generic privacy notice that does not contain detailed information. We propose to create privacy notices directly from the source of the Android applications where personal information is used and processed. In this work we present our approach that can identify and extract source code

that processes personal information. We create a tool called PDroid that implements this approach. With this tool we can identify which personal information is accessed, how it is used in the application, and help developers create concise and consistent privacy notices using this information. We use this tool to analyze ~80,000 Android applications and extract ~300,000 code segments that use and process personal information.

533. Investigating 3D-Printability of a Maine-Based Bio-Ink

Submission Category: Engineering and Information Sciences

Author(s): Jordyn Judkins

Faculty Mentor: Bashir Khoda

Abstract:
Biofabrication is the process of creating complex biologic products, such as artificial tissues, from raw materials such as living cells, biomaterials, and molecules. This can be done using 3D printed bio-ink, which is a combination of biomaterials and cells. However, the bio-ink must be a shear thinning fluid to allow for high-resolution and continuous printing (printability), but also demonstrate post-printing mechanical integrity to self-support the structure (shape fidelity). Achieving printability and shape fidelity simultaneously is a challenging issue due to how the chosen biomaterials interact with each other. If the interactions are too strong, the printability will be low, but if the interactions are too weak, the shape fidelity will be low. The research conducted here investigates how to improve the mechanical functionality of bio-ink using additives available in Maine. Chitosan, which can be extracted from shrimp, sodium alginate, which comes from algae, and TEMPO nanocellulose fibers, which is a forest biproduct, were chosen as the candidate biomaterials due to their biocompatibility. The printability of the bio-ink can be determined by considering the rheological properties and printing parameters, such as pneumatic pressure and nozzle size, for numerous mixtures. This research focuses on how the mixture ratio affects the printability of the bio-ink, while also investigating the individual material contributions. To determine how chitosan changes the behavior of the ink, the rheological data of four ink compositions will be compared, and a “design of experiments” approach will be used to determine which hydrogel ink produced the smallest filament width when printed, therefore revealing which ink composition will print with best quality. The four ink compositions used are 2:1:0.1 w/v%, 2:1:0.5 w/v%, 2:1.5:0.1 w/v%, and 2:1.5:0.5 w/v% of Alginate:TEMPO-NFC:Chitosan. A flow curve, amplitude sweep, and rotational thixotropy test are conducted for each ink to gather viscosity and modulus values data. Each ink is then printed with a 3D printer using air pressure at 10 psi to force the ink through a 410 micron needle, with a printing height of 0.3 mm. The ink is printed and sprayed with a crosslinker of calcium chloride

over a 5 by 5 cm area, then a picture of the ink is taken and uploaded into ImageJ, where the filament width can be determined. Based on the analyzed data thus far, increasing the amount of chitosan in the bio-ink decreases the filament width of the printed bio-ink. Looking at the rheological data, increasing the chitosan content of the bio-ink increases the ink's viscosity, which makes sense with the corresponding filament width decrease. This means increasing chitosan content leads to a bio-ink that has higher printability.

534. A Custom Centrifuge Tube and for the Collection of Microliter Volume from a Microneedle Skin Patch

Submission Category: Engineering and Information Sciences

Author(s):
- Cole Perry
- Caleb Berry
- Scott Collins

Faculty Mentor: Rosemary Smith

Abstract:
Microfabricated, silicon needle arrays are being developed at UMaine for the extraction of dermal interstitial fluid (ISF) for off-chip compositional analyses. The microneedle patch collects a minute volume of approximately 1 µL of ISF into an on-chip microfluidic reservoir. ISF removal from the microneedles has been achieved using centrifugation, whereby the liquid is expelled from the patch and pools at the bottom of the tube from where it is pipetted out. Commercially available centrifuge tubes do not permit optimal positioning of the microneedle patch inside the tube and pipetting results in a significant loss of fluid. Using a 3D computer-aided design (CAD) software, a custom centrifuge tube and cap were rendered to accommodate and position the microneedle patch. Additionally, the custom centrifuge tube is designed to enable extraction in the tip. This is achieved by puncture of a 50-micron membrane at the tip. The custom cap features a housing that positions the microneedle patch at an optimal 45° angle. A hole in the housing beneath the microneedle patch allows ISF to pass through and into the tip during the centrifugation process. While the tube and cap are designed to work together, the cap is designed to also be compatible with commercial centrifuge tubes. The tubes and caps are 3D printed at the UMaine IMRC CORE facility. The custom tubes are being tested with patches loaded with 1 µL of water in a centrifuge to ensure instrument compatibility and to assess improvements in efficacy of collection through design optimization.

535. Compact VO2 Max Testing Device

Submission Category: Engineering and Information Sciences

Author(s):
- Zane Kwiatkowsky
- Quinn Ferguson
- Shanna Scribner
- Nathan Loranger

Faculty Mentor: Michael Mason

Abstract:
VO2 max is the maximum oxygen consumption of a person during strenuous physical activity and is valuable for tracking athletic progress however, devices used for testing are expensive, lack ergonomics, and only cater towards a narrow market composed mainly of competitive athletes at the highest level. Personal VO2 max testing machines remain costly being upwards of $5000 making it evident that companies have yet to develop a cheap alternative to meet the demand. The team designed a new compact VO2 max device with the intentions of addressing the market's needs and to provide affordable at home testing to athletes at every level. We have conceptualized and built the device under the target budget of $300. Initial testing of the device indicates the ability to accurately measure heart rate via the heart rate sensor incorporated within the device. Additionally, the device is able to measure the oxygen air flow out of a patient while the oxygen air flow in is estimated as the amount does not vary significantly from patient to patient with the exceptions of outliers. The oxygen sensor was 99.7% accurate with the measurement being around ±0.05% of the actual oxygen concentration. A series of additional tests are to be conducted verifying the level of comfort, durability, and portability of the device. Right off the bat, it was clear that using both a Raspberry Pi and Arduino may not be feasible as the combined size does not work well with the given size constraints. This promising new device addresses the main issues with the current devices in the VO2 max market which, in theory, should massively increase the overall availability for individuals that are interested in purchasing a VO2 device.

536. Solar Power System for Forest Bed Sensing

Submission Category: Engineering and Information Sciences

Author(s): Victoria Nicholas

Faculty Mentor: Ali Abedi

Abstract:
Solar-powered electrical systems are of the utmost importance when studying remote ecosystems, due to the ability of the system to produce power in nearly any environment without disturbing the test site. Current power solutions, including battery-powered systems, disturb the research environment by requiring human interference to recharge the system, which will affect the collected data. This solar-powered system will eliminate this problem by charging itself so that very little human disturbance of the research environment occurs.

537. Fabrication of Metallic Organic Frameworks on Carbon for Water Treatment

Submission Category: Engineering and Information Sciences

Author(s): Aidan McGlone

Faculty Mentor: Yingchao Yang

Abstract:
Metal-organic frameworks (MOFs) are a scientifically compelling and functionally evolving class of meso-, micro- and ultra-microporous materials. The crystalline MOFs have a large and permanent molecular-scale porosity, which is up to 90% free volume. The MOFs may have an ultrahigh surface area up to 7,000 m2/g. All these unique characteristics bring MOFs a broad potential application, such as gas storage, chemical separation, catalysis, and energy conversion. The focus of this research is to grow selected MOFs nanostructures on porous carbon which is converted from balsa and bass wood sheets. The hybrid structures are expected to be used to remove organic compounds in water. To increase the nucleation and enhance the growth of MOFs in the porous carbon, the carbon has been pretreated by a piranha acid solution to get a hydrophilic surface. The chemicals to synthesize MOFs include copper nitrate trihydrate and benzene tricarboxylic acid mixed in varying amounts in different solutions. A hydrothermal method is employed to complete the reaction at relatively low temperature and high pressure. Currently, two morphologies, particles and fibers, have been successfully synthesized. The hybrid structures are being tested to absorb methyl orange (MO) under visible and UV light for different period. The fiber-like MOFs has a reaction with the MO that turned the color to a neon orange.

538. Protecting Privacy in the Heterogeneous Internet of Things

Submission Category: Engineering and Information Sciences

Author(s):
- Sanonda Gupta
- Aubree Nygaard
- Stephen Kaplan
- Vijayanta Jain

Faculty Mentor: Sepideh Ghanavati

Abstract:
Internet of Things (IoT) is a term used when two or more devices (or "things") embedded with sensors are deployed in a physical world and are capable of collecting and transferring data over the internet. The increasing growth of IoT devices raises a wide range of privacy concerns, such as inconsistencies between the application and its privacy policy, inference of the personal information of the individual, and lack of detailed privacy notice mechanisms for the users. Previous research attempt to address some of these privacy concerns, however, very few work focus on heterogeneous IoT environment (i.e., smart home as an example). To address this research gap and to protect individuals' privacy while using IoT devices, we propose a privacy protection framework for the heterogeneous IoT network. Our proposed framework aims at identifying potential privacy risks associated with a new IoT device and generate a detailed privacy notice for the user. We evaluate the functionalities of our framework with four IoT applications from four different categories. The preliminary analysis shows that our proposed framework can help the user to understand potential privacy risks associated with a new IoT device and make an informed decision before the device installed within the network.

539. Wavelet-Based Automatic Pectoral Muscle Segmentation from Mammograms

Submission Category: Engineering and Information Sciences

Author(s): Basel White

Faculty Mentor: Andre Khalil

Abstract:
As a pre-processing step to the computational analysis of thousands of mammograms, the pectoral muscle and image background need to be excluded from each mammogram. This task is

currently done manually and takes an unacceptable ~3 minutes/mammogram. Thus, an automated breast segmentation algorithm has been developed, based on an adaptation of the 2D Wavelet Transform Modulus Maxima (WTMM) segmentation method through the use of the program Xsmurf and programming language Tcl/Tk. The output of this algorithm is two binary images: one representing the region of the mammogram bounded by the pectoral muscle, and another image region bounded by the entire breast region. These two images are then used to create the automatic mammographic mask. Currently, the algorithm consists of user thresholds needed to be set for each mammogram. Thus, a cost function has been developed to analyze what combination of size and mean modulus threshold percentile produce the most optimal binary mask, and in turn, allow for the implementation of a global percentile threshold. In order to evaluate mammographic masking efficiency, the Sorenson-Dice Overlap Similarity Coefficient is incorporated into the cost function.

540. Cellulose Nanofibrils Aerogels and Iron Oxide-based Nanoparticles for Arsenic Removal From Drinking Water

Submission Category: Engineering and Information Sciences

Author(s): Md Musfiqur Rahman

Faculty Mentor: Islam Hafez

Abstract:
A novel arsenic adsorbent was prepared from cellulose nanofibrils (CNF) and Mg-doped iron oxide nanoparticles (IONP). Using nanoparticles as adsorbents in the treatment of drinking water at a commercial scale is challenging due to the lack of a well-established and sustainable system to contain them. In addition, the used materials are often non-biodegradable. The IONP was incorporated into CNF aerogels by simultaneously freeze-drying the synthesized IONP and CNF suspension. The synthesized IONP had a higher specific surface area of 165 m2/g compared to other iron oxide-based nanoparticles, which is essential for better arsenic adsorption. Scanning electron microscopy images of the aerogels revealed a uniform distribution of the IONP onto the fibrils. The adsorbent showed a high affinity towards arsenic (III) and (V) (up to 99% removal) following a pseudo-second order kinetic model.

541. Development and Optimization of Droplet-Forming Dip Coating Process

Submission Category: Engineering and Information Sciences

Author(s):
- Aimee Co
- Karissa Tilbury

Faculty Mentor: Bashir Khoda

Abstract:
Dip coating, a wet deposition method is extensively used due to its simplicity, low cost, and reasonable control over the thickness. During the withdrawal of the substrate, the mixture velocity is directed downward and a layer is entrained. The film thickness results from a balance between the viscous drag, and the capillary rise. The thickness of the layer depends upon various parameter of the liquid and dipping process (i.e., withdrawal speed, viscosity, surface tension etc.). Above a threshold thickness, hydrodynamic instability will trigger formation of droplet whose topology can be controlled for various application such as filtration, material transfer, 3D cell spheroid etc.
The goal of this study is to develop and optimize a new method of droplet or spheroid formation on fiber through a hydrogel dipping process. The adjustment of fiber and hydrogel characteristics allows for control over droplet characteristics. The factors currently being considered for the optimization of the droplet are the fiber diameter and fluid viscosity while the dipping process mechanism parameters are kept constant. By keeping the parameters of dipping speed and submersion time constant, the relationship between the concentration of the chosen hydrogel, alginate, and the diameter of the chosen fiber, PLA, is being observed through the calculation of the resulting droplet volume. The volume calculations of the droplets-on-fiber are highly dependent on the droplet peak diameter, wetting length, and contact angle. Measurements taken of the droplets post-dipping showed that the droplet size increased with diameter as well as hydrogel concentration.

542. Developing the SMART Cane for the Visually Impaired

Submission Category: Engineering and Information Sciences

Author(s):
- Jordan Miner
- Kora Kukk
- Natalie St. Louis
- Jennifer Triana

Faculty Mentor: Caitlin Howell

Abstract:
Currently there are 285 million visually impaired people in the world, and in the US, the number of blind and visually impaired (BVI) individuals is expected to double from 12 million to 24 million by the year 2030. [1] Although there are many existing technologies to help the BVI population, there is still a need for a commercially available device which can reliably combine multiple technologies to give users and, if needed, their health-care providers with navigational and biometric feedback. To develop a solution, our team built the Safe Mobile Aide with Reliable Technology (SMART) Cane that intuitively combines multiple pre-existing technologies through a simple, easy to use interface that aids users in mobility and orientation. The four major components of the device include: navigational assistance, overhead obstacle awareness, fall detection, and haptic and auditory feedback to the user. All components have undergone extensive testing to ensure the device is reliable. The GPS chip in the cane was found to accurately measure the coordinates corresponding to the user's location. The cane's proximity sensor was found to accurately measure objects within 6 feet. Lastly, the accelerometer was over 90% accurate in detecting if the cane fell. Future tests will be used to understand how all the components interface together into one seamless design. The overall goal of the SMART Cane is to help to address the ever-growing needs of the aging population and assist in providing the BVI population with more options for navigating daily life.

543. Concentrating Viruses From Sewage for SARS-CoV-2 Monitoring

Submission Category: Engineering and Information Sciences

Author(s):
- Kettie Rose Cormier
- Audrie French
- Harrison Cyr

Faculty Mentor: Jean MacRae

Abstract:
Wastewater based epidemiology (WBE) is an approach to health monitoring that uses detection of pathogens in wastewater to track the incidence of public health issues. It has the advantage of integrating the results of the entire community, so it is anonymous, and is less expensive than testing individuals. The goal of my research was to develop a simple, inexpensive lab test for the detection of the SARS-CoV-2 virus in wastewater. I compared methods for concentration of the virus from wastewater samples, and extraction of RNA from the concentrate to try to develop simpler, ideally field-deployable methods that use only equipment that is inexpensive and readily available at wastewater treatment plants. Concentrated virus preparations produced from

surrogate virus-spiked wastewater samples were obtained using a Polyethylene Glycol- 8000 precipitation method, and a Nanotrap Magnetic Bead concentration method. RNA from the concentrated samples was either extracted and purified using an IDEXX magnetic bead extraction kit, or released by simple heat treatment. The concentrated viral nucleic acids were tested using two different detection methods: the Reverse Transcriptase Loop-Mediated Isothermal Amplification (RT-LAMP) method, which can be done without access to expensive instrumentation and is a colorimetric qualitative method, and the Quantitative Polymerase Chain Reaction (qPCR) method, which uses more expensive instrumentation, but is a proven method that provides a quantitative reading of viral copies in each sample. Comparisons between the results will be made so that the relative best method can be developed for a given sample type and management goal.

544. Wireless Soil Moisture Sensor Network

Submission Category: Engineering and Information Sciences

Author(s):
- Thayer Whitney
- Tori Nichols
- Sonia Naderi

Faculty Mentor: Ali Abedi

Abstract:
Forest ecosystem monitoring with high spatial-temporal resolution is of paramount importance for development of accurate prediction models. Current systems are bulky, use high power, and are costly to build and maintain. By using a low cost and power efficient wireless sensor network for soil moisture monitoring, it is possible to circumvent these pitfalls while providing increased resolution.

545. Imaging Zebrafish with Duchenne Muscular Dystrophy using Second-Harmonic Generation to Evaluate Myosin Structure

Submission Category: Engineering and Information Sciences

Author(s):
- Jordan Miner
- Andre Khalil

- Clarissa Henry
- Elisabeth Kilroy

Faculty Mentor: Karissa Tilbury

Abstract:
Duchenne muscular dystrophy (DMD), an incurable disease that causes weakness and loss of muscle mass, is caused by a mutation in the protein dystrophin. Myosin is a key protein required for proper muscle contraction and is impacted by DMD. By evaluating sarcomere length and myosin arrangement, we seek to understand the structural impacts of four different exercise regiments: endurance, hypertrophy, strength, and power on the myosin in zebrafish. Currently, confocal microscopy is used to study the two muscle fiber types: slow- and fast-twitch. However, confocal microscopy uses dyes, whereas second harmonic generation (SHG) imaging is label-free and will not distort the myosin structure. By comparing the myosin structure of wild-type and DMD zebrafish, an understanding of the effect DMD has on myosin can be determined. Preliminary results demonstrate a reduced sarcomere length in DMD zebrafish when compared to wild-type zebrafish. Additionally, DMD zebrafish exercised with neuromuscular electrical stimulation (NMES) to emulate endurance strength training show an increase in sarcomere length when compared to non-stimulated DMD zebrafish. Furthermore, a 2-D fast Fourier transform (FFT) approach is currently being developed to increase sensitivity to myosin remodeling in the DMD zebrafish model. Overall, this study will effectively combine SHG imaging with the use of zebrafish to optimize muscular myosin evaluation, furthering our knowledge of DMD.

546. Abstract Withdrawn

547. Strain Sensor for Harsh Environments

Submission Category: Engineering and Information Sciences

Author(s): David Leff

Faculty Mentor: Mauricio Pereira da Cunha

Abstract:
Strain sensing in high-temperature, hard-to-reach locations is needed in powerplants, aerospace, and advanced industrial applications for structural health monitoring, condition-based maintenance, increasing process efficiencies, safety, and maintenance cost reduction. Sensing

challenges under these conditions include mounting, sensor stability, and data acquisition. Surface acoustic wave (SAW) sensors respond to these demands, as they can operate above 1000°C, are sensitive to temperature and strain, compact, operate wirelessly, and operate without a battery. Wireless strain sensing has been performed at UMaine in high-temperature furnaces up to 400°C. It was found through these tests that after heating, the SAW sensitivity to strain decreased due to cracking of the sensor crystal /adhesive/metallic part interfaces. The differences in the coefficient of thermal expansion between the adhesive, the sensor crystal, and metallic part are believed to be at the center of the identified adhesive failure under excursions between room temperature and high temperature. In this work, modeling in COMSOL Multiphysics was done to study the effects of strain in the mounted SAW due to thermal expansion differences between a metallic surface where strain is being monitored, the adhesive, and the SAW sensor. Simulations with different adhesives and different adhesive shapes were performed to identify alternative mounting methods to minimize the strain at the metallic part/adhesive/sensor interfaces due to thermal expansion while still transferring strain from the metallic part to the SAW sensor. The simulations revealed that the strain on the mounted sensor changes with adhesive shape and type of adhesive used, which can be used to eliminate cracking.

548. Compact VHF and UHF Antennas for Integration With SAW Devices in Harsh Environment

Submission Category: Engineering and Information Sciences

Author(s): Sri Lekha Srimat Kilambi

Faculty Mentor: Mauricio Pereira Da Cunha

Abstract:
A Normal Mode Helical Antenna (NMHA) is a combination of short electric dipole and short magnetic dipole. Due to the reduced size with respect to the wavelength, the NMHA structure has a low value of radiation resistance when compared to conventional antennas used around 300MHz frequency range. The NMHA is reported to operate and provide gain in close proximity to a metallic reflecting surface, which can be an advantage in complex industrial and power plant environments. This type of coil antenna structure is used in car smart keys to turn on the car from a distance.
To study the properties of the NMHA, the coil structure has been connected to microstrip transmission lines of different lengths. It has been identified that the size of the nearby microstrip ground plane affects the NMHA structure impedance, resonant frequency, and the radiation properties. In addition, the impedance of NMHA coil structure also depends on the orientation of the coil with respect to the microstrip ground plane. The unbalanced radiating structure was

connected to a coaxial cable through a balanced-to-unbalanced (BALUN) device in an attempt to characterize its input impedance. The experimental results are compared with the simulation results from WIPL-D and HFSS. This antenna structure is planned for integration with wireless SAW sensors targeted to operate in harsh environments.

549. Particles Sorting From Poly-disperse Mixture Using Dip-coating

Submission Category: Engineering and Information Sciences

Author(s): Md Ibrahim Khalil
Faculty Mentor: Bashir Khoda

Abstract:
When a substrate is submerged in liquid solution with a relative velocity (rotational speed) between the object and liquid bath, a thin layer of liquid is observed over the object. The thickness of the layer, in submerged condition, depends on the properties of the liquid, especially the percentage of binder used in the solution. When the substrate is fiber, the radius of the substrate has a significant impact on the thickness of the liquid film over the fiber. If the liquid solution contains particle in it, particles entrain into the polymer layer. The entrainment of the particles in the polymer layers is dictated by the trade-off between the viscous force between the layer and the particle and centrifugal force on the particle due to rotation of fluid. Moreover, the size of entrained particles depends on the concentration of the binder used in the solution. When the concentration of binder is low, only small particles entrain into the polymer layer. However, at low binder concentration the large particles remain in the solution as the layer thickness is insufficient to hold the larger particles. Using this phenomenon, an effective filtration process of the particle from poly-disperse particle mixture is shown in this work. The fiber has greater control over the filtration process as well as the size of the entrained particle over the substrate. In this study, the filtration mechanism is observed in submerged condition by dipping a fiber (cylindrical rod) into a solution containing particles. As fiber is used, different regimes are observed at various concentration of binder in the solution. The regimes are classified based on the size of the entrained particles over the substrate. In this work, three different entrainment regimes are found with the variation of binder concentration for the sorting of particles from the poly-disperse particle mixture. Low particle regime, where the diameter of the particles entrained into the polymer layer is smaller than the other regimes. On the other hand, the medium particle regime is characterized by particle sizes that are both greater and equal to those of the previous regime. Finally, the large particle regime is where particle of all sizes (small diameter to large diameter) entrained into the polymer layer from the suspension. Due to the entrainment of particles with a range of diameters, this process leads to a superior filtration process of the poly-disperse particle mixture over the capillary filtration processes.

550. Lighter Than Air Technology for Remote Sensing Applications

Submission Category: Engineering and Information Sciences

Author(s): Hamza Azzam

Faculty Mentor: Alex Friess

Abstract:
Over the past decade, there has been renewed interest in lighter-than-air (LTA) airship technology, as they have the unique ability to stay aloft with negligible, or in some cases without, energy supply. This property makes them significantly cheaper for certain applications. Therefore, the work proposed in this abstract focus on designing a small-scale airship suitable for remote sensing applications. The closed-loop design algorithm contains multiple modules: such as shape module, aerodynamics module, buoyancy module, weight module, structure module, control module, and stability module. The following modules have been completed to date:
A shape module that generates the shape inside SolidWorks, this includes creating the conventional “Gertler shape” and defining and creating a new hybrid shape family, which is composed of elliptical sections driven by a parametric flattened and truncated ellipsoid and a symmetric NACA airfoil cross-section, that allows simple shape adjustments.
An aerodynamic module that includes generating the drag, lift, and moment forces and coefficients for different shapes through CFD simulations inside Ansys Fluent 2020 R-1.
A buoyancy module that computes the hydrostatic lift that can be obtained from the contained gas in the hull volume.
A weight module that computes the total weight (payload, system, and the envelope weight) that has to be balanced by the aerodynamic and the aerostatic lift.
Once the algorithm is complete, a specific shape, with specific dimensions and specific structure, will be designed for the required remote sensing mission.

551. Mechanical Performance of 3D Printed Lattice Structures: Assembled Vs Direct Print

Submission Category: Engineering and Information Sciences

Author(s):

- Adeeb Alam
- Keith Berube

Faculty Mentor: Bashir Khoda

Abstract:
To fill a three-dimensional space cellular solids or, lattice structures can be used instead of solid materials, to get high mechanical performance with lower density. These low-density high-performance structures are used in applications like mechanical, phononic, thermal, and biological fields. However, the possibilities of lattice structures are often unaffordable due to design and manufacturing limitations. Extrusion based 3D printing, which can be defined as incremental deposition of one or two dimensional forms of raw materials, has the potential to be used in fabricating porous structures. Here, an extensive study is done on the fabrication of lattice structures using extrusion based 3D printing.
From Maxwell's criteria, we have bending and stretch dominated lattice structures which depend on the nodal connectivity of the struts. Stretch dominated structures generally show significantly higher mechanical performance than bending dominated structures. Primitive cubic and Octet, which are representatives of bending and stretch dominated structures, were 3D printed by applying both direct printing and assembly methods. To compare the mechanical properties, lattice structures were manufactured with variable density. The density was varied by altering the cell size or strut thickness. Assembly based designs can give us much versatility in printing lattice structures with lower density using less manufacturing time, because of continuous toolpath and ability to print without support.
A comprehensive study is done to find mechanical properties of both Cubic (bending dominated) and Octet (Stretch dominated) structures manufactured by both direct and assembly methods. Mechanical strengths of these porous structures were compared by using the power law given by Gibson and Ashby.

552. Contact Tracing Via Bluetooth Beacons

Submission Category: Engineering and Information Sciences

Author(s): Jacob Mealey

Faculty Mentor: Michael Scott

Abstract:
Over the past year, the world has been facing the Covid-19 pandemic, forcing the University of Maine to take precautionary measures. In an effort to find better such measures, Asap Media Services (ASAP) has conducted research on various forms of contact tracing since April 2020. At ASAP, we have built a low-power Bluetooth device that will be placed in every room broadcasting a unique identifier, along with a companion smartphone application that scans for Bluetooth devices. This will track where every member of the community is at all times so that, should someone test positive for Covid-19, we can easily get in contact with anyone who may

have contracted the virus from that person. ASAP is conducting a test on a small sample of students who are working in the office.

553. Sailing Velocity Prediction Program

Submission Category: Engineering and Information Sciences
Author(s): Andrew Arter

Faculty Mentor: Alex Freiss

Abstract:
The Sailing Velocity Prediction Program focuses on creating a computer program to simulate the velocities that a sailing craft will reach under different variable conditions. Over the past hundred years, sailing has transitioned from a major mode of transportation into a luxury activity and a very competitive sport. As the sport of sailing has progressed, sailboats have been reaching higher velocities, which is due to the increase in the understanding behind the physics of sailing. A program to predict the velocity of sailing crafts is crucial to the design stage of the vessels. The program balances the forces on the craft to generate a velocity polar comparing the boat speeds to the boat's angle to the wind. Where this program diverges from current commercial programs employed by designers is that it focuses on sailing crafts that use hydrofoils. The project then examines the ways to optimize the hydrofoils to maximize potential velocity for a given set of parameters. The parameters include size, shape, and camber of the foil. The end results would be compared to the most recent iterations of the most advanced sailing crafts that use hydrofoils.

554. Exploration of Olfactory Interventions as a Synergistic Emotional and Cognitive Recovery Technique

Submission Category: Engineering and Information Sciences

Author(s): Leah Parrish

Faculty Mentor: Nimesh Ranasinghe

Abstract:
Work-stress is a significant health concern in today's society, and with COVID-19 forcing us to adapt to even more stressful situations, mental health self-care and recovery from work stress are quickly becoming more common priorities. Our goal is first, to investigate how the quality of

recovery from online work stress varies based on how the individual recovers from that stress. Secondly, to investigate how these different recovery techniques can be integrated to develop more effective recovery experiences. Trials consist of participants going through a series of work and relaxation tasks, tracking their emotional state and work productivity through the study. We will be presenting our preliminary findings using a combination of digital games and scent stimuli for work-stress recovery. Our future work will continue to explore and develop novel digitally controlled olfactory interventions for work-stress recovery.

555. Durability Evaluation of Carbon Fiber Composite Strands in Highway Bridges

Submission Category: Engineering and Information Sciences

Author(s):
- Braedon Kohler
- Roberto Lopez-Anido
- Andrew Goupee
- Keith Berube

Faculty Mentor: Roberto Lopez-Anido

Abstract:
The United States has been suffering from increasingly aging and decrepit infrastructure systems, and given that most bridges in the US are over 50 years old there is some work to be done in improving these structures. Carbon Fiber Composite Strands (CFCS) are a newer material that have similar strength properties of steel, however, unlike their traditional counterparts they have substantially higher resistance to corrosion. This material shows promise to help strengthen and improve our structures, but whether it is durable enough to compete with steel still needs to be determined. The Penobscot Narrows Bridge in Verona Maine is a stay-cabled bridge with two CFCS in three of its stays. These strands were installed in 2007 and have been monitored throughout the bridge's lifespan. To better understand the durability of these strands, this project aims to install a wireless data acquisition system at the bridge to collect real time data of the CFCS performance. The system includes a variety of instrumentation including load cells, fiber-optic strain sensors (FOS), temperature sensing both internally and externally, and Linear Variable Differential Transformers (LVDTs). Using a network of wireless nodes and a central base station at the center of the bridge pylon, the sensing network will connect to a central computer and will acquire data continuously while also being remote accessible. The system will be controlled through a combination of the nodes innate program and LabVIEW programming to merge the wireless and FOS data. Using this data in combination of a theroelastic model, this project aims to make a durability assessment of CFCS.

556. Slimming Neural Networks using Adaptive Connectivity Scores

Submission Category: Engineering and Information Sciences

Author(s):
- Dawsin Blanchard
- Madan Ravi Ganesh
- Jason J. Corso
- Salimeh Yasaei Sekeh

Faculty Mentor: Salimeh Yasaei Sekeh

Abstract:
There are two broad approaches to deep neural network (DNN) pruning: Weight-based methods which determine importance scores via the weight matrices, and probabilistic methods which aim to capture the flow of information in the network. Each approach's advantage supplements the missing portions of the alternate approach yet no one has combined and fully capitalized on both of them. Further, there are some common practical issues that affect both such as manually analyzing sensitivity and setting pruning limits. In this work, we propose Slimming Neural networks using Adaptive Connectivity Measures (SNACS), as an algorithm that uses a probabilistic framework for compression while incorporating weight-based constraints at multiple levels to capitalize on both their strengths and overcome previous issues. We also propose a hash-based estimator of Adaptive Conditional Mutual Information (ACMI) to evaluate the connectivity between filters of different layers, which includes a magnitude-based scaling criteria that leverages weight matrices. To reduce the amount of unnecessary manual effort required to set the upper pruning limit of different layers in a DNN we propose a set of operating constraints to help automatically set them. Further, we take extended advantage of weight matrices by defining a sensitivity criteria for filters that measures the strength of their contributions to the following layer and highlights critical filters that need to be protected from pruning. We show that our proposed approach is faster by over 17x the nearest comparable method and outperforms all existing pruning approaches on three standard Dataset-DNN benchmarks: CIFAR10-VGG16, CIFAR10-ResNet56 and ILSVRC2012-ResNet50.

Arts

Projects 601 - 614

Arts

601. Postal Project

Submission Category: Arts

Author(s): Rochelle Lawrence

Faculty Mentor: Susan Lynn Smith

Abstract:
In response to the financial crisis and leadership controversies at the United States Postal Service that the COVID19 Pandemic and 2020 Presidential Election brought attention to, the Postal Project was created. This project aimed to bring awareness to these issues as well as to show support for the postal workers tasked with processing more mail and packages than ever before. The USPS is a non-partisan public service and the only service that will deliver mail to any and every address in the United States making it a pillar of democracy. In this project, mail art was used to both express gratitude to postal workers and to educate mail recipients of the crisis. Each adorned envelope included a letter explaining the controversies and offered information about the petition that the American Postal Workers Union is using to create awareness towards a change in legislation. In this two-part mailing, the first mailing asked participants to create art supporting the USPS and continue the mail chain by both sending mail art to someone else and posting it to #artistsformail on the Instagram platform. The second part was an adorned envelope with the contents of a “Save the USPS” sticker to place on the recipient's mailbox to show support to the mail carrier. The third part of the project was to create a website that documents the project and provide information found while doing research for the project. The visual outcomes of the project were documented on the website as well as at #artistsformail.

602. Shadow Box Theater

Submission Category: Arts

Author(s): Drake Perkins

Faculty Mentor: Jon Ippolito

Abstract:
I’m looking to create small shadow theaters that can be a fun customizable art project. The goal is to create several small kits with materials to create several scenes from Japanese mythology, as

well as material to create your own scenes of any kind. Along with the premade scenes would be illustrated cards that depict the myths the scene is from for educational purposes, and to get people interested in the folklore.

603. Pinus longaeva: Discovering Form and Value through Ancient Bristlecone Pine Trees

Submission Category: Arts

Author(s): Delaney Burns

Faculty Mentor: Andy Mauery

Abstract:
I will develop an ongoing series of 20” by 30” woodblock prints that explore the forms and textures of bristlecone pine trees through abstracted imagery and patterns. By keeping the form abstracted as opposed to in a literal landscape, it keeps an edge of mystery and invites multiple interpretations and narratives. This will draw the audience in and provoke them to think about what meaning these trees have to us and to the environment. The goal of this project is to explore the intersections of science, art, and sense of self. Bristlecone pine trees play an important role in understanding climate change and I want to use these prints to open up a larger conversation about the role art can play in understanding science and personal identity. I will also be researching contemporary artists who also work with natural abstraction. Tara Donavan and Ursula von Rydingsvard are two contemporary artists who bring natural influences into their larger scale sculptures to reflect the free movement of nature. Additionally, I will be researching more about bristlecone pine trees and the role they play in studying climate change. My goal is, through printmaking, to connect the personal importance bristlecone pines have to me with their role in understanding climate change.

604. Curious the Cat and the COVID-19 Quarantine

Submission Category: Arts

Author(s): Jacob Stutzman

Faculty Mentor: Susan Lynn Smith

Abstract:
We are currently living through unprecedented circumstances due to the global COVID-19 pandemic. But despite the many obstacles that have arisen over the past year, the world has continued to function with relative normality thanks to the labor and sacrifices of essential workers. Since filmmaking is a core component of my artistic practice, I created a documentary short that captures the experiences of essential workers in Maine. The goal of my documentary short is to show that there is more to an essential worker than their occupation, and to highlight their human side and personal struggles during the pandemic.

I believe that one of the groups that has been most affected by the pandemic is young children. Because of this I have filmed the documentary in a style that is accessible and engaging for young viewers. I use interviews with essential workers such as teachers, police officers, fire fighters, and farmers to highlight that adults are dealing with many of the same hardships as children. During these interviews, the essential workers not only discuss their experience of working through a pandemic, but they also explain different methods and techniques that they use to deal with feelings such as fear and boredom. Through these interviews along with narration by a puppet called Curious the Cat, my documentary seeks to capture the experiences of essential workers in Maine while also teaching children more about essential jobs and how to cope with their feelings and confusion during these uncertain and frightening times.

605. MoodTracker: The Journal App that Visualizes Your Mood

Submission Category: Arts

Author(s): Jared Steinbrecher

Faculty Mentor: Jon Ippolito

Abstract:
The project that I will be presenting is my app called MoodTracker. This is my senior capstone project for New Media. What started out as an idea for my introductory Mobile Applications course project over a year ago, has evolved into a mental health tracking app. As you can imagine, this has been extremely useful to me during the strange times we live in. This app will simplify the process of keeping a typical journal by asking you only three simple questions every day. The app will ask you to explain your day in four words, to give your day a rating out of five, and write a note if anything significant happened that day. On top of the simplicity of this journal, it is also able to combine this data in order to visualize how your mood was over a week, a month, or a year. This is accomplished through the use of charts and beautifully displayed statistics. Visualizing the data like this provides a concise snapshot of your mental health over a

period of time and lets you analyze what might be affecting your mood. Once you know what might be affecting your mood in a positive or negative way, you can formulate plans for the long and short term in order to improve and maintain your mental health.

606. Four Sacred Medicines

Submission Category: Arts

Author(s): Christiana Becker

Faculty Mentor: Susan Lynn Smith

Abstract:
Most people today don't connect or use plants for medicinal and ceremonial benefits. In Indigenous cultures, we have four sacred plants that are often used as offerings to the spirits or our ancestors, as protection, prayer and cleansing the mind and body. I've created a book that illustrates the four sacred plants: tobacco, sage, sweet grass, and cedar. The pages of the book unfold accordion style and on the inside of the cover there is information about each plant, such as the English word and Penobscot word for the plant and what the plant is culturally used for. I made this book as a remembrance of Indigenous culture and to share it with others.

607. The Journey of Perseverance - A Rover’s Perspective, from Inception to Launch (Phase 1 of A Large-Scale, Multiple-Phase, Socially-Engaged Art & Science Installation Series)

Submission Category: Arts

Author(s): Anna Soule

Faculty Mentor: Shawn Laatsch

Abstract:
Mars 2020! The Journey of Perseverance – A Rover's Perspective will be an on-going, large-scale, multiple-phase, Socially-Engaged Art & Science Installation Series. This series will offer a personified visual narrative of Perseverance Rover's perspective and engagement with its creators, its journey into space towards the Red Planet, its exciting landing on Mars on February 18, 2021, and its many explorations and adventures while in two-way communications with Mission Control. With plenty of light-hearted humor mixed in with scientific facts and the

wonder of space and planetary exploration, this project will include an interactive component of 5-part deliverables for dissemination to "the public" upon completing the Research and Development associated with each phase. The 5-part deliverables for Phase 1: Inception to Launch will include (1) a 3-5 minute video animation/short for video projection mapping at the planetarium, (2) a site-specific sculpture with artist book, (3) a series of Limited Edition Artist Multiples with Family-Friendly Activity Kit and Deluxe Collector's Edition options, (4) a series of mission-related fun and educational workshops/webinars, and (5) a miniature Mars Mission Ambassador Passport for collecting stamps/stickers for completion of certain mission-related activities that will be available throughout this phase of the installation. Any R&D in the form of conceptual sketches and data collected (i.e., text/image/audio) for each of the prototypes-in-process for Phase 1: Inception to Launch's 5-part project deliverables will be video presented for UMSS21 with completion of final artifacts and artworks tentatively scheduled for distribution and installation over the 2021 Summer Semester.

608. Whites Only

Submission Category: Arts

Author(s):
- Anna Soule
- Derek Smith
- Stanley Levitsky

Faculty Mentor: Owen Smith

Abstract:
“Whites Only” is a collaborative video performance/installation that touches on white privilege and assimilation to white culture and systemic racism in America. Co-authors Anna Soule, Derek Smith and Stanley Levitsky collaboratively conceptualized this art installation and video performance as part of a group project for IMD 561: Project in Collaborative Production (Research Studio II) in Spring of 2020 just before the COVID-19 Pandemic shut down the campus. The installation’s physical structure and parts were assembled and constructed by Smith and Levitsky, with Anna Soule’s performance captured by Levitsky and Soule, as Cinematographer and Editor, respectively. Levitsky’s cinematography was directed at Soule’s actions in a relaxed style to make a more natural observation of the installation’s message of race and privilege, without anger or conflict. It is a communication that illustrates how certain racist behaviors are deeply integrated and accepted within our societal norms; here presented as a gentle way of changing how we think about and perceive the inherent biases within the assimilation of white culture across the United States.

609. UMaine AR Campus Touring UniAR

Submission Category: Arts

Author(s): Thanisorn Jarujinda

Faculty Mentor: Jon Ippolito

Abstract:
My intention is to create a mobile application that helps newcomers who are interested in taking a tour navigate the University of Maine campus. Unlike traditional app-based tours, this application will be based on augmented reality (AR) with the support of animation-based characters that helps provide information and location. The social intervention such as AR drawing, AR stickers, or AR graffiti etc. might be patched to the app in the later stage to bring more interaction between people. This application will also link to many social media platforms to make it easy to stay connected.

610. MicroMacro Space Connected

Submission Category: Arts

Author(s): Thomas Griffith

Faculty Mentor: Susan Lynn Smith

Abstract:
My work as an artist and a graduate student is centered around how we define what a space is. This defining includes asking how spaces interact with each other, us, and the other inhabitants. Using various media forms, I experiment with merging spaces and bringing elements of one space into other spaces. In this, I am challenging preconceptions about the world and hopefully promoting critical thinking skills.

The microscopic and tiny macro spaces that we can only view with microscopes and the macro lens are often presented with more scientific documentarian characteristics. I propose to utilize these same tools to explore and document these spaces but to present them with a more expressive artistic characteristic personal aesthetic. The material will be presented in video form and ready for the web. I hope that offering an audience a more expressive and personal style of these spaces can create more connection to the world that goes unseen to most and, in some sense, bring this space into ours. Most seldom examine these spaces and go about their day while

what happens in the tiny and microscopic worlds has substantial effects on all of us and the environment that we live. By bringing this other space into ours, it is hoped this will contribute to the audience to think more critically about our choices as a society.

611. Illustrations Challenging Tropes of LGBT+ Individuals

Submission Category: Arts

Author(s): Spencer Atkinson

Faculty Mentor: Lois-Ann Kuntz

Abstract:
Current LGBT+ representation in the media is not sufficient, often being prone to tropes that can be harmful to those in the community, or lacking in other categories such as race and body types (Hunte 2020, Jordan 2018, and Kaiser 2017). As various media are often controlled by those outside of this community, finding a way to help straight and cis people understand these issues and notice the same patterns will likely lead to change. This project for a psychology class is meant to simplify these issues in the form of individual pictures to get the point across quickly and easily by incorporating 'flipping the script' which reverses a situation unexpectedly. Four images were designed with queer (used to refer to people in the LGBT+ community as an inclusive adjective), and sapphic (refers to women that experience attraction to other women) characters.
It is hoped that when notified, non-LGBT+ people can notice the same patterns, and this can be achieved through the use of images that showcase the subversion of tropes, inclusion, or common assumptions ultimately reducing harmfulness.

612. Presence, in Time and Space, Subject to Changes and Actions of Others

Submission Category: Arts

Author(s): Katarina Hoeger

Faculty Mentor: Susan Lynn Smith

Abstract:
Our current being experiences our present, acknowledging the past and the hope of a future. What were our pasts? How do we engage with our presents? How do others, other humans, other

organisms, other ideas, other objects, come into play? Our experiences are not isolated but impacted by others. The artist uses her work to explore these concepts using time-based media.

613. Inside Art

Submission Category: Arts

Author(s): Owen Savage

Faculty Mentor: Jon Ippolito

Abstract:
For my capstone I am creating an interactive VR environment that can be explored by many users at one time. The environment will be modeled after an artwork of my own. The idea is to allow users to jump inside the work of art and explore what it is like to be inside of it as well as interact with other users. When inside of the environment users can communicate with friends or random other users. The environment will be accessible through a QR code that comes as part of the purchase when someone purchases a print out of the artwork. The artwork could ideally also serve as a venue for a variety of shows, poetry, comedy and other events. These shows would be held by avatars of real people who would perform much like they would at any other venue.

614. Ease Meditations

Submission Category: Arts

Author(s): Caitlyn Sharples

Faculty Mentor: Jon Ippolito

Abstract:
Ease is a website that provides grounding meditations and projectable animations for individuals who are in need of immersive relaxation. Ease has a customizable approach where users can create their own personalized meditation choosing whatever visual animations, pre-recorded meditations, guided speakers, and music they find the most relaxing. The animations can be played on personal devices or projected at home for a relaxing immersive experience. The website will also include a gallery of user submitted meditations, where users that are part of the ease community can submit meditations they have found beneficial.

Ease was created with the intent of helping those struggling with mental health, especially anxiety, while trying to cope with the isolation of a worldwide pandemic. General Anxiety Disorder (GAD) and mental health disorders have been a prevalent issue before the coronavirus pandemic according to the U.S. census. In 2014, only 17% of Americans described symptoms of GAD, contrasting the March 2020 census where one third of Americans reported symptoms of anxiety. In April and May of 2020, the U.S. Census also reported that Americans are 3 times more likely to screen positive for not only anxiety disorders but depressive disorders than they were in the past.

Caitlyn Sharples, the creator behind ease, saw a need to create tools to help combat these mental health disorders in hopes of revolutionizing the methods individuals use to manage their mental health. If this method proves to be successful, it can serve as a prototype for future in person installations that would allow for a fully immersive experience.

Social Sciences and Humanities

Projects 701 - 746

Social Sciences and Humanities

701. Are Adverse Childhood Experiences Associated with Worse Cognitive Function in Older Adults?

Submission Category: Social Sciences and Humanities

Author(s):
- Amy Halpin
- Angelica Boeve
- Sahvannah Michaud
- Michael Fagan
- Rebecca MacAulay

Faculty Mentor: Rebecca MacAulay

Abstract:
Objectives: Adverse childhood experiences have been associated with increased risk for dementia. However, prior research is mixed regarding the relationship between early life adversity and cognition and remains understudied in older adult populations. Therefore, the current study aimed to characterize associations among early life adversity with relevant risk factors and cognitive performance in a group of socioeconomically diverse older adults. Participants and Methods: Participants included 121 community-dwelling older adults (74% female, Mage=70.7) without diagnosis of moderate to severe psychiatric, cognitive, or neurological disorders. A comprehensive neuropsychological battery was used to assess estimated verbal/non-verbal intelligence, visual/verbal memory, working memory, executive function, processing speed, and attention. The Adverse Childhood Experiences (ACE) questionnaire measured childhood experiences of sexual and physical abuse, neglect, and household dysfunction. ACE groups were formed based upon the number of adverse events endorsed. Results: Over 56% of older adults reported an adverse childhood event. ACE scores were positively associated with lower socioeconomic status (lower education and income). There were no significant differences in estimated intelligence or neuropsychological performance between low and high ACE groups; however, the latter group reported significantly less self-efficacy and higher levels of depression and subjective cognitive concerns. Discussion: Early life abuse and neglect did not have a direct association with cognitive function but did associate with psychological factors associated with risk and resiliency for dementia. Given the high prevalence of abuse, future research should place emphasis on addressing these modifiable risk factors in efforts to attenuate risk for future cognitive decline.

702. Effects of the Transportation and Climate Initiative Program on the Maine Economy: An Analysis of Cap-and-Invest and its Heterogeneous Impacts on Rural and Urban Households

Submission Category: Social Sciences and Humanities

Author(s): William Somes

Faculty Mentor: Jonathan Rubin

Abstract:
In December 2020, a memorandum of understanding (MOU) was released by the Transportation and Climate Initiative Program (TCI-P), a collaboration of 13 jurisdictions in the New England and Mid-Atlantic regions of the United States. Modeled on the Regional Greenhouse Gas Initiative (RGGI), the TCI-P follows a cap-and-invest framework to reduce emissions from the transportation sector by 26% from 2022 to 2032. Since the TCI-P is expected to raise the price of gasoline by 5¢ to 9¢ per gallon, there has been concern that some populations may be disproportionately affected. The present research studies the potential heterogeneous impacts of the TCI-P on rural and urban populations within the state of Maine. The author hypothesizes that rural Mainers will be more sensitive (i.e., elastic) to changes in the price of gasoline, leading to a disproportionate economic burden for this population.
Research methods rely on a short-run household price elasticity of demand estimate from Spiller, Stephens, and Chen (2017), which is adapted to reflect the demographic characteristics of rural and urban households in Maine. Elasticities were weighted according to their relative importance. Reductions in households' transportation emissions are calculated for each population, along with the economic loss and burden, to reveal the expected heterogeneous impacts of the TCI-P in Maine. Results found a short-run, weighted elasticity for rural households of -0.97. The adapted elasticity for urban households was found to be -0.75, for a Maine average of -0.87. Given price increases of 5¢ or 9¢, rural households were shown to face relatively small but disproportionate economic losses and burdens as compared to urban households. The additional cost to rural households is estimated to range from $52 to $92 per year, while the cost to urban households is estimated to range from $51 to $91 per year. These costs represent between 2% and 4% of fuel expenditures for the average Maine household. The economic burden of a 9¢ increase in the price of gasoline amounts to approximately 2% of the variable costs of driving a used vehicle and just 1% of the total driving costs of a used vehicle. The median household income in rural and urban Maine is $53,701 and $60,571, respectively. The author concludes with a series of investment portfolios and messaging and communication strategies that have the potential to increase public support for the TCI-P. This research provides key insights into potential heterogeneous impacts on Maine households while contributing to the public discourse on an important topic in climate policy.

703. Wabanaki Tools of Diplomacy and LD 291: Storying Protocols as Political Will

Submission Category: Social Sciences and Humanities

Author(s):
- Nolan Altvater
- Bridie Mcgreavy
- Darren Ranco

Faculty Mentor: Darren Ranco

Abstract:
Oral history suggests Wabanaki people have inhabited what is now New England and the Canadian maritimes since time immemorial, and for at least 13,000 years according to archeological records. Throughout this existence, the Wabanaki survived by adapting to the surrounding environment by creating and using tools relevant to their epistemological and ontological foundations; their ways of knowing and being. These tools were not just physical, handheld objects, but also took the form of words and images. Two examples of these tools within Wabanaki epistemes include wikhikonal, birch bark carvings, and wapapayil, wampum. Both of these tools and their processes involve a specific diplomatic protocol and synergy that needs to be maintained in order to be used and create change in the physical environment. Using Indigenous Research Methodologies in conjunction with Decolonizing Methodologies (Smith, 2012), this project explores how these tools have been used throughout time by the Wabanaki for diplomatic and storying purposes. Our research provides an epistemological analysis of the tools, exploring their concepts and how they were used before and during early contact with Western systems. Additionally, it explores how, despite adapting to Settler Colonialism and attempted epistemicide, the same protocol and synergy is still applied to their new forms in modern contexts, showing the skill of cultural dynamism of the Wabanaki. The project then connects this analysis to the current context of the Wabanaki Studies Law (LD 291), responding to and supporting the development of the needed protocol and action for successful implementation of this law.

704. Understanding Current Public Sentiment Towards Biologically Engineered Food Products

Submission Category: Social Sciences and Humanities

Author(s):
- Kathleen Tims

- Ek Han Tan

Faculty Mentor: Ek Han Tan

Abstract:
While commonplace in our grocery stores, GMO-foods have persevered through years of controversy. Availability of BE commodities is growing and agrobiotechnical industries are making strides, however the average consumers' knowledge concerning biotechnology is not. Pew Research Center recently found that a majority of their American participants responded as unsure when asked if GM foods were safe to eat and that younger groups responded more wary of potential risks (1). Other studies show that younger adults report having very little knowledge about GMOs and more than half of their student respondents evaluated GMO-food as "dangerous and unfavourable" for human health (2). Both the general lack of knowledge regarding biologically-engineered commodities reported by young adults, especially students, and the recent USDA-AMS mandate for BE product labeling prompts further research into consumer perspective on bioengineered products (3).

My thesis project includes a combination of both literature review, helping contextualize my investigation, and statistical data review and collection. I look to explore the prevailing student perspective on biotechnology using digital social questionnaires to garner anonymous, qualitative information, focusing on individual BIO350 Genetics students' perspectives towards topics such as GMOs, knowledge of BE products, and BE labeling. This information will be analyzed with respect to how education, through an undergraduate genetics course, plays a role in forming these attitudes.Considering their growing presence in our food systems, scale of public misconception, and the approaching BE labeling compliance date, consumer concerns and attitudes towards GMO products and bioengineering must be evaluated.

Works Cited

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Jurkiewicz, A., Zagórski, J., Bujak, F., Lachowski, S. & Florek-Łuszczki, M. Emotional attitudes of young people completing secondary schools towards genetic modification of organisms (GMO) and genetically modified foods (GMF). Ann. Agric. Environ. Med. AAEM 21, 205–211 (2014).
Overview of The National Bioengineered Food Disclosure Standard Feb 2019.

705. Preliminary Effects of Brief RO DBT Intervention on Dyadic Social Interaction and Overcontrol in Young Adults

Submission Category: Social Sciences and Humanities

Author(s): Jennifer Hugg

Faculty Mentor: Cynthia Erdley

Abstract
Those with excessive inhibitory control, or 'overcontrol,' are more likely to experience high threat sensitivity, low reward sensitivity, inhibited emotional expression, low sensation-seeking behavior, perfectionism, and involvement in aloof or distant relationships (Lynch, 2018a). Radically Open Dialectical Behavior Therapy's (RO DBT) hallmark skill (Match +1) has been found to enhance social connectedness for overcontrolled persons (Lynch, 2018b). The purpose of the present study is to examine whether the Match +1 skill might be effective in improving social interactions in a normative sample. The planned sample will include 100 participants recruited through the University of Maine. To date, 32 have participated (22 female, 10 male, Mage = 20.84 years, SDage = 4.451, age range: 18-36 years, White = 75.0%, Two or More Races = 12.5%, Black = 9.4%, American Indian/Native American = 3.1%). Dyad members who were known to one another participated virtually on Zoom in a conversational task with the option to use conversation prompts. Dyads were assigned to either the Match +1 condition or the control condition. A mixed effects regression model was used to control for dependency. Although preliminary analyses revealed no changes in positive or negative mood pre- to post-conversation, a significant Condition X Overcontrol interaction ($p = 0.029$) on social connectedness was found. For those in the Match +1 group who were overcontrolled, ratings of social connectedness were significantly higher as compared to the other groups. This suggests that young adults who are overcontrolled may be especially receptive to the benefits of this intervention.

706. Systemic Language Discrimination in the United States

Submission Category: Social Sciences and Humanities

Author(s): Stephanie Tillotson

Faculty Mentor: Zachary Ludington

Abstract
Language discrimination, legally prohibited in all sectors of US society by the International Covenant on Civil and Political Rights and theoretically curtailed by US judicial precedent, remains widespread in many areas of US society. Longstanding patterns of language discrimination persist in widely varying contexts with disparate legal requirements, making understanding language discrimination comprehensively a complex legal and ethical task. Scholars have taken up the task only relatively recently, developing the field of Linguistic Human Rights to address the legal, social, and ethical questions involved. The present project surveys some discrete forms of language discrimination in the United States which have not previously been understood as examples of a broader historical and systemic pattern. The goal of the research is to synthesize a general concept of language discrimination in the United States from heretofore unconnected phenomena. It will be shown that American society's blindness to language discrimination qua language discrimination belies such discrimination's systemic nature; such discrimination is subtly resistant to existing international and domestic legal prohibitions, even as it runs counter to the U.S.'s concept of fundamental rights.

707. How Alumnae of a Feminist Organization Perceive their Involvement as Related to Their Academic Self-concept during Middle-High School

Submission Category: Social Sciences and Humanities

Author(s): Miranda Snyder

Faculty Mentor: Susan K. Gardner

Abstract:
Research has found that youth involvement in activism can benefit sense of self and belief in one's abilities to make positive change for those involved through unique communication with people who are passionate about the same issue, a sense of personal empowerment, and a deepened sociopolitical consciousness to understand the complexities of social-justice issues. This qualitative study provided greater understanding of how youth perceive their involvement in a feminist organization related to their academic self-concept in middle-high school. Six alumnae of the Girls Advisory Board (G.A.B.) of Hardy Girls Healthy Women, a Maine-based nonprofit that focuses on the empowerment of young women, were interviewed. Participants were asked to reflect on their experiences and perceptions of themselves in activist organizations, specifically in GAB, and academic situations. Findings indicated that alumnae recalled community-oriented affordances of activism, a high work ethic, increased personal understanding and empowerment via activism, and a multi-faceted academic self-concept that incorporates their own and others' perceptions as related to their involvement in activism during middle-high school.

Suggestions for youth looking to be involved in activist organizations and schools aiming to increase students' academic self-concept are drawn from this study's findings. For instance, youth hoping to increase their sense of importance and community should be encouraged to join or participate in efforts sponsored by youth-led activist organizations. Schools may also work toward increasing self-driven learning opportunities for students and offer an array of activism-based practices for students to engage in, such as service-learning-based efforts.

708. Assessing the Relationship Between Adverse Childhood Experiences, Working Memory, and Perceived Stress in Older Adults

Submission Category: Social Sciences and Humanities

Author(s):
- Sahvannah Michaud
- Amy Haplin
- Angelica Boeve
- Rebecca MacAulay

Faculty Mentor: Rebecca MacAulay

Abstract:
Objectives. Adverse childhood experiences (ACE) are associated with several deleterious outcomes across the lifespan. Given evidence of working memory (WM) difficulties in those with high ACE scores and associations between perceived stress and WM impairment, the present study aimed to better understand the relationship between WM and ACE in older adults and whether this relationship was moderated by perceived stress. Methods. Data collected from 121 participants enrolled in the Maine Aging Behavior Learning and Enrichment study was used. The ACE Questionnaire measured number of and type of early life adverse events. The Wechsler Adult Intelligence Scale-IV digit span tests evaluated auditory WM. The National Institute of Health-Cognitive Toolbox List Sorting Test measured visual WM. The Montreal Cognitive Assessment measured global cognition. The Perceived Stress Questionnaire evaluated levels of subjective stress. Hierarchical multiple regression analyses investigated the effect of ACE on visual and auditory WM. Moderated regression analyses investigated the effects of perceived stress scores. Results: Results revealed that ACE scores contributed to 3.7% of the variance in visual WM performance, after adjusting for age, education, and global cognition, $F(4, 116) = 9.15$, $p < .001$. ACE scores were not significantly associated with auditory WM. Perceived stress, while positively associated with ACE scores, did not significantly affect the relationship between WM and ACE. Conclusions: ACE exhibited a domain-specific effect upon WM. Further investigation of visual as compared to auditory effects on cognition may lead to an improved

understanding of underlying neurological mechanisms involved in cognitive decline in those with ACE.

709. How Androcentric are University Forestry Program Cultures? A Cross-Institutional Qualitative Case Study of Undergraduate Forestry Student Experiences

Submission Category: Social Sciences and Humanities

Author(s):
- Emily Roth
- Jessica Leahy
- Mindy Crandall
- Laura Kenefic

Faculty Mentor: Jessica Leahy

Abstract:
Forestry, like other natural resource sciences, is a field dominated by men due to the continuing systemic exclusion of other genders. One route of perpetuating this exclusion is the use of gendered language, which refers to discourse that tends to favor the hegemonic gender in forestry. A common example of gendered language is the use of he/him/his pronouns when referring to a hypothetical, genderless group, such as professional foresters. In this study, we aim to understand undergraduate forestry students' gender-based experiences, particularly in relation to gendered language. A total of twenty students from Society of American Foresters accredited majors at one East Coast Land Grant University (LGU1) and one West Coast Land Grant University (LGU2) were selected to be interviewed from a volunteer form sent to all potential participants. Selections were based on cohort, gender, and major, so as to equally represent gender minorities (women and non binary) and majorities (men). Using Zoom as a platform, we asked questions designed to understand the impact of gendered language in university forestry program settings on undergraduate students, identify changes in students' gender-based experiences throughout their college career, assess students' university experiences in terms of diversity and inclusion, and identify obstacles students have noted that can enhance university inclusion practices. Preliminary results indicate that the use of gendered language in university forestry programs is frequent and perpetuates gender minority students' feelings of exclusion and inability. Previous research has not focused on the unique intersection of gendered language and undergraduate forestry programs, and with this study, we hope to further discern the intricacies of gender diversity in forestry, promote the use of gender-fair language, and potentially provide information to forestry educators about gender diversity, equity, and inclusion.

710. Abstract Moved to Another Category

711. Abstract Moved to Another Category

712. Role of Chronic and Acute Stress in the Development of Obesity Between Members of Different of Socioeconomic Groups

Submission Category: Social Sciences and Humanities

Author(s):
- Isabelle Stevens
- Shelby Helwig
- Shannon McCoy

Faculty Mentor: Shannon McCoy

Abstract:
Obesity is a global epidemic and has been declared the largest unrecognized health problem by the World Health Organization. The many comorbidities of obesity make it a highly deadly disease and America is one of the countries most greatly affected by this epidemic. Identifying risk factors is essential in reducing the prevalence of obesity. Social inequality, measured by socioeconomic status (SES), is associated with disparities in health outcomes, including obesity. In the current project, I examined the role of chronic and acute stress in the development of obesity between members of different socioeconomic groups, specifically showing that these effects can be observed in young adults. UMaine college students completed a self-report survey measuring their socioeconomic status before arriving for an experiment in the laboratory. During the experiment, students participated in a stressful activity (i.e., giving a 5-minute recorded speech about their future goals and plans to a judge) while their cardiovascular responses, including their heart rate variability and blood pressure, were recorded to measure their typical stress response. After the experiment, I recorded body measurements such as weight, height, and waist circumference. The relationships between SES, stress reactivity, and obesity and the implications for these results are discussed. These results may inform public health practices to emphasize reducing social inequalities as an effective strategy for reducing the overall prevalence of obesity and health disparities.

713. Moved to Late Breaking Abstracts

714. The Stigmatization of Formerly Incarcerated Citizens

Submission Category: Social Sciences and Humanities

Author(s):
- Amy Frankel
- Sydney Massa
- Marina Slover

Faculty Mentor: Elizabeth Depoy

Abstract:
Previous studies have primarily explored the topic of stigma with family members of incarcerated citizens (Gueta, 2018), (Saunders, 2018), (Tadros, Fye & Ray, 2020), currently incarcerated women (Bove & Tyron, 2018), and gender specific groups of men and women, at a similar stage in their reentry process (Bahr, Armstrong, Gibbs, Harris & Fisher, 2005), (Celinska, 2000), (Gunn, Sacks & Alexis, 2018), (Riccardelli & Mooney, 2018). Building on the important body of knowledge as the basis for facilitating the reentry and positive adjustment of this population, the aim of this mixed-methods study is to examine the nature of stigma in the lives of males and females who share the experience of being incarcerated, and who have spent varying lengths of time back in their communities following their completion of a term of incarceration. Our research questions are: What is the degree of stigma experienced by formerly incarcerated citizens? To what extent does our population offer insights beyond what is found in existing literature? What insights are relevant for dissemination? We rely on the classic definition of stigma generated by Goffman, an “attribute that is deeply discrediting,” which reduces an individual “from a whole and usual person to a tainted, discounted one.”

Methods
Beginning our study by conducting interviews is the most appropriate and culturally sensitive way to engage our population. Purposive and snowball sampling will be used to recruit participants who meet the criteria for our study. Following a mixed-methods approach, we will use interviews, consisting of six, open-ended questions, as our method of data collection. Qualitative data will utilize thematic analysis. Once we have completed our qualitative analysis, responses to our open-ended questions will be assigned response categories to enable quantitative analysis. Interviews will be conducted by phone to allow for privacy and in consideration of current Covid-19 restrictions. The findings will add to the current knowledge base and inform praxis with this population.

715. The Impact of COVID-19 and Telehealth Usage for Recovery Program Participants at Seaport Community Health Center

Submission Category: Social Sciences and Humanities

Author(s):
- Sarah Juster
- Colleen Keegan
- Kate Pontius
- Priscilla Domingo
- Samuel Roy

Faculty Mentor: Elizabeth Armstrong

Abstract:
Concurrent to the COVID-19 pandemic, the opioid epidemic continues to escalate in the United States. In Maine, a 27% increase of overdose deaths was recorded in the first half of 2020 compared to the prior 6 month period. This study examines the impact of COVID-19 on recovery processes and treatment access for participants in a medication-assisted treatment program in mid-coast Maine using both paper and electronic surveys. We hypothesized that mechanisms for poorer recovery outcomes would include increased social isolation, financial stress, and mental stress, and that lower rates of technology ownership and privacy at home would lead to lower approval ratings for Zoom-based group therapy. Preliminary analysis of early responses (N=14) suggests a statistically significant correlation between increased social isolation and poorer recovery outcomes during COVID-19, as well as between increased mental stress and poorer recovery outcomes. Fewer than half of initial respondents reported owning a computer with Zoom capability, although internet stability and privacy at home were not reported as major barriers to Zoom-based group therapy. Data demonstrating the impact of COVID-19 on recovery processes and treatment access is of critical value both to the specific treatment center involved in this study as well as to the broader field of substance-use disorder-related research.

716. The Effects of Different Curricula on Perceptions of the Science-Religion Relationship

Submission Category: Social Sciences and Humanities

Author(s):
- Darby Casey
- Sally B. Barker

Faculty Mentor: Jordan P. LaBouff

Abstract:
Science and religion appear to clash in many ways regarding how we understand the world around us. A current example is how some religious organizations are lobbying against COVID-19 restrictions on religious grounds in order to have more people in their places of worship. However, many people see science and religion as compatible (e.g., many religious scientists). Education is a powerful force for changing people's attitudes and promoting cooperation, yet little research has been done regarding its impact on the perception of science and religious compatibility. The purpose of this study is to determine whether different curriculums (religiously diverse vs traditional general education) have an impact on student's perceptions on the science-religion relationship. Specifically, we are comparing the honors program versus non-honors programs at the University of Maine to see if students in either curriculum differ in their beliefs towards science and religious compatibility. Students in either HON 112 or PSY 100 were recruited to complete self report measures of religious compatibility, religious commitment, and one's identity as a religious person or scientist. We expect that students in a more religiously diverse curriculum will express more compatible attitudes between science and religion. Results could inform curriculum decisions and help understand the relationship between science and religion.

717. Cardiovascular Effects on Cognition in Young Adults: The Relationship Between Exercise, Physical Activity, and Processing Speed

Submission Category: Social Sciences and Humanities

Author(s):
- Taylor McMillan
- Lindsey Lagerstrom
- Jennifer Thompson

Faculty Mentor: Fayeza Ahmed

Abstract:
Cardiovascular disease (CVD) is a well-established risk factor for cognitive decline and is likely to accelerate the onset of Alzheimer's disease (AD).1 Evidence suggests moderate intensity exercise is effective at reducing cardiovascular risk, while higher intensity exercise may offer greater cardioprotection.2 General physical activity has long been associated with a decreased risk in CVD.3 The purpose of the current study is to identify the relationship between exercise intensity, general physical activity, and processing speed to potentially identify early vascular

effects on cognition. College-aged participants (N = 113) were recruited from the Middle Age: Cognition, Activity, and Health study database, that includes measures of cognition, motor/sensory activities and cardiovascular health. Participants were administered the NIH Toolbox, where they completed measures of processing speed. Processing speed was examined in relation to average daily physical activity (total steps as measured by FitBit) and intensity of structured exercise (metabolic equivalent; MET). Results indicated there were no significant correlations between MET, FitBit active minutes, and processing speed. However, total self-reported exercise minutes (β = .32) accounted for significant variance in processing speed (R2 = .10, Adj R2 = .09, SEE = 17.95, F (1, 111) = 12.11, p = .001). While behavioral symptoms of AD (e.g., memory loss) do not occur until late adulthood, neurophysiological changes precede these much earlier. Additionally, processing speed is regarded as one of the most correlated cognitive domains impacted by age.4 This study aims to identify possible changes among young adults to identify opportunities for early intervention.

718. Community Support for Low-Income Elementary School Students with a Winter Gear Drive under COVID 19 Constraints

Submission Category: Social Sciences and Humanities

Author(s): Paige Wentworth

Faculty Mentor: Lois-Ann Kuntz

Abstract:
Washington County has the highest rate of children living below the federal poverty level in the state of Maine (Walsh, 2012). Winter can be especially difficult and financially lean with below freezing temperatures, higher fuel costs, and many industries basically shut-down in the long winter months. Local schools have collections of hats and gloves that children share. This year due to COVID 19 restrictions, children could not reuse winter gear from another child. Similarly because of constraints, schools were using gyms for extra classroom space. Students without winter gear in many cases could not participate outside and were at a disadvantage. These students miss the well-documented benefits of free play and during COVID, they are inside all day with masks (Brez & Sheets, 2017). The project that will be described included a 3-week hat and mitten drive and the development of a flyer of local resources that low-income individuals could utilize. Money was donated along with a total of 400 items of winter gear and the elementary schools discreetly distributed items to backpacks. Children growing up in poverty are likely to have worse mental and physical health unless there are supportive relationships that may offer protection (Hostinar & Miller, 2019). Continued attention to harnessing community support as a protective factor and building resilience in low-income children; if not breaking the

cycle of poverty, at least offers the possibility of future citizens who will in turn be supportive community members.

719. Moved to Late Breaking Abstracts

720. Sleep Health Domains Differentially Impact Aspects of Executive Function in Older Adults

Submission Category: Social Sciences and Humanities

Author(s):
- Angelica Boeve
- Amy Halpin
- Michael Fagan
- Sahvannah Michaud

Faculty Mentor: Rebecca MacAulay

Abstract:
Objective: Sleep health and executive function are multifaceted constructs that decline with age. Some evidence suggests that poor sleep health may underlie declines in executive function but this relationship is not consistently found in cognitively normal older adults.
Method: The present study systematically investigated distinct sleep health domain associations with specific aspects of executive function to clarify mixed findings in the literature. Community-dwelling older adults completed clinical interviews, comprehensive neuropsychological assessment and subjective measures of sleep. Four sleep health domains were investigated: satisfaction/quality, sleep efficiency, sleep duration, and daytime sleepiness/fatigue. Hierarchical multiple regressions analyses examined whether the sleep health domains differentially predicted executive function. Results: After adjusting for significant covariates, separate analyses found that: greater sleep efficiency predicted better inhibitory control and greater daytime sleepiness/fatigue predicted worse cognitive flexibility performance. Sleep duration, satisfaction and quality did not demonstrate any statistically significant associations with executive function measures. Additionally, performance on working memory or problem solving/concept formation did not associate with sleep health. Conclusions: Our findings align with evidence that suggests that sleep efficiency and daytime fatigue may underlie difficulties with inhibitory control and cognitive flexibility. These results support the need to evaluate the effect of sleep efficiency and daytime sleepiness/fatigue on cognitive test

performance. Further, these findings potentially indicate that interventions that target these sleep mechanisms may help to reduce declines in executive function.

721. Abstract Moved to Another Category

722. Parent-Adolescent Relationships of International Boarding High-School Students

Submission Category: Social Sciences and Humanities

Author(s):
- Kittiya Reeves
- Jessie Anderson
- Kristen Brewer

Faculty Mentor: Daniel Puhlman

Abstract:
Many scholars have explored parent-adolescent relationships during the period of adolescent transition. Hofer & Moore (2010) stated that parents who monitor their children tend to continue to do so after high school, and for many families, this continues through the year after the children graduate from college. Over monitoring from parents might be more harmful to children than be beneficial or supportive. It is challenging for international students and parents to maintain their relationships over long distances. This qualitative study examines the relationships between international students who study in the United States and their parents who live in their home countries. The study focuses on how parents and children communicate over long distances and the difference in their communication at home. The study also examines how the COVID-19 pandemic has shifted this communication and subsequently impacted their parent-child relationships. Interviews were conducted with twelve students who are studying abroad, and five of their parents who live overseas. The findings from this study will help us better understand the parent-adolescent relationships of international boarding high-school students. It will also help us better understand the adjustments and adaptations that parents and students make to maintain bonds, and communication for better and healthy parent-child relationships when living internationally.

723. A Lens Model Approach to the Nonverbal Expression of Fatigue

Submission Category: Social Sciences and Humanities

Author(s): Morgan Stosic

Faculty Mentor: Mollie Ruben

Abstract:
Chronic fatigue syndrome, characterized by persistent mental fatigue and severe physical disability, significantly impairs several components of performance including speed and accuracy, hand-eye coordination, and decision-making and memory. Learning how to detect chronic fatigue through nonverbal markers (i.e., eye movements, facial expressions) is an important avenue for research as it will allow for outside observers to be trained to accurately identify fatigue and intervene in performance-based jobs where accidents and errors are critical. Therefore, the purpose of the current research was to identify objective, nonverbal behaviors associated with chronic fatigue and examine if naïve observers were accurate at detecting fatigue in others. In phase one, participants or targets (N = 64) were videotaped having a 5-minute "getting-to-know-you" conversations with another person and completed a validated measure of chronic fatigue. In phase two, new participants (N = 82) were recruited to watch 30-second clips of these interactions, and judge how much fatigue they perceived the targets to be experiencing. Finally, in phase three, the recordings from phase one targets were subjected to rigorous nonverbal coding by objective coding softwares, as well as by trained research assistants in order to determine which specific nonverbal cues were the most reliable predictors of chronic fatigue, as well as whether perceivers were utilizing these cues in their assessment of fatigue. In addition, we correlated targets' self-reports of chronic fatigue with perceivers' judgments of fatigue in order to determine overall levels of accuracy in detecting fatigue in others. Implications related to human and artificial intelligence fatigue detection are discussed.

724. Moved to Late Breaking Abstracts

725. Joe Polis and the Search for the Northern Highlands

Submission Category: Social Sciences and Humanities

Author(s): Jacob McCarthy

Faculty Mentor: Kreg Ettenger

Abstract:
Joe Polis (1809-84) was a well-known Penobscot leader. Scholars have examined his Penobscot language writings (MacDougall, 2000) and his relationship with Henry David Thoreau (Lynch,

1997), but little is known about his role in the Northeast Boundary Commission of 1838. Preceding the Webster-Ashburton Treaty of 1842, the northeast border was contested. Several previous surveys had been completed without settling the issue (Carroll 2001). In 1838 Maine Governor Edward Kent charged John G. Dean with leading the Northeast Boundary Commission north of the St. John River to identify the highland referenced in the 1783 Treaty of Paris as the northern border (Deane, 1838). Deane hired Polis to guide his trip. While Deane and trip surveyor William Parrott did not mention Polis in their final reports, a close examination of Deane's personal journal reveals that Polis played a critical role in the commission's success. By comparing the official accounts of the trip with Deane's personal journal, this research illuminates Polis's significant contributions and raises questions about the visibility of Native American guides in historical documents.

726. Communicating Carcharodon carcharias Forecasting and Conservation Using eDNA Analysis From the Gulf of Maine

Submission Category: Social Sciences and Humanities

Author(s): Bradlyn McEttrick

Faculty Mentor: Jessica Reilly-Moman

Abstract:
In recent years, the presence of Carcharodon carcharias (Great White shark) has risen in New England coastal waters, attracting research attention and public concern (Curtis et al., 2014). Tools for shark detection exist, but have not been aggregated for use in spatial or temporal forecasts in the New England area, however it has been accomplished in warmer waters (Lafferty et al., 2018). Following the first recorded fatal shark attack in Maine in July 2020, researchers at the Bigelow Laboratory and the University of Maine began testing the capabilities of environmental DNA (eDNA) to detect white sharks with the goal of using eDNA and existing tools to forecast white shark presence in the Gulf of Maine. However, researchers face multiple communication challenges, specifically in communicating about new detection technology, forecast uncertainty, apex ocean predator conservation efforts, and the effects of climate change on white shark presence in Maine. Consequently, we created a strategic communication plan to identify potential stakeholders while integrating communication strategies for eDNA science with ongoing white shark conservation efforts. The plan supports internal collaborative dialogue and highlights potential external partnerships for researchers on the Maine-eDNA project; it explicitly identifies potential communication challenges, and it illuminates opportunities to increase understanding of both eDNA science and white shark conservation. By developing a strategic communication plan, we aim to not only support improved science communication for

emergent eDNA forecasting, but to also bolster wider stakeholder interest in C. carcharias conservation efforts as their presence increases in our rapidly changing climate.

References

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727. Maine's Rural Youth: Exploring Migration Plans through Place and Community Attachment Theories

Submission Category: Social Sciences and Humanities

Author(s):

- Zachary Davis
- Kathleen Bell
- Mindy Crandall

Faculty Mentor: Jessica Leahy

Abstract:

Rural youth out-migration can intensify workforce shortages, population declines, brain-drain, and other social and economic issues that threaten the sustainability of rural communities in Maine and across the United States. In this research, we advance knowledge of youth migration decisions by incorporating measures of place and community attachment. We focus on testing for positive associations between the desire to live in a rural area and place attachment as well as community attachment. We designed and administered a survey to 666 middle and high school students in Piscataquis and northern Somerset County in 2019 (response rate=87%). Using 578 survey responses provided by students from 5 schools, we use regression and statistical tests to assess empirically the associations between the stated desire to live in a rural area and measures of place and community attachment. In addition to measuring place and community attachment, we control for relevant economic factors (e.g., age, income, and stated human capital goals). Results reveal positive associations between place and community attachment and the desire to live in a rural area. In contrast, advanced education goals were negatively associated with the

desire to live in a rural area. Our findings suggest that by using policies and practices that build both place and community attachment, rural communities could influence the future migration decisions of rural youth. We highlight actions families, schools, non-profit community organizations, and private businesses could take to create opportunities for rural youth to build place and community attachment and foster community well-being.

728. The Impact of Mental Health Stigma on Hireability

Submission Category: Social Sciences and Humanities

Author(s): Cassidy McCusker

Faculty Mentor: Mollie Ruben

Abstract:
Society tends to view those with mental illness as dangerous, impulsive, and unstable. These perceptions are often made quickly, with very little information available, and have lasting impacts (e.g., impacting job opportunities). The purpose of the current research is to examine stigma associated with various mental health disorders as compared to a physical health disorder or no disorder on perceptions of warmth, stability, openness, competence, and hireability of a candidate for a job. Undergraduate participants (N = 329) rated deidentified medical forms as part of a job application that varied in terms of diagnosis (depression, anxiety, bipolar disorder, or schizophrenia), past hospitalization (yes vs. no), medication use (yes. vs. no), and gender (male, female, gender nonconforming) on hireability. It was hypothesized that stigma, as judged by lower ratings of hireability, would vary as a consequence of mental health disorder. Additionally, it was hypothesized that past hospitalizations and medication use as a result of mental illness would affect hireability ratings. Finally, we examined how the perceiver's own experiences with mental health impacted their hireability ratings. Results showed that hireability ratings varied by mental health diagnosis such that those without a mental health diagnosis or with a physical health diagnosis were significantly more likely to be hired compared to those with anxiety, depression, bipolar disorder, and schizophrenia, in that order. Perceiver mental health experience impacted ratings of hireability such that those with mental health experience themselves were more likely to hire others in general, while those with no mental health experience were less likely to hire applicants. Implications of this work include informing interventions that reduce barriers in seeking mental healthcare, especially during the COVID-19 pandemic, when mental health symptoms are at an all time high.

729. Honors and Eating Concerns

Submission Category: Social Sciences and Humanities

Author(s):
- Ailin Liebler-Bendix
- Jamie Ginguere
- Ethan Lowell
- Bailey Lewis

Faculty Mentor: Jeffrey Hecker

Abstract:
The focus of this project is to explore the relationship between pathological disturbances in eating, food ideation and the incidence of perfectionism in honors students at the University of Maine. Our research group is composed of four undergraduate students that are part of the UMaine Honors College, as well as two professors. The literature we have reviewed suggests that high levels of perfectionism are linked with the development of maladaptive eating behaviors. We formulated two hypotheses; 1) Honors college students will demonstrate high levels of either self-orientated perfectionism or socially prescribed perfectionism; 2) Socially prescribed perfectionism will be positively correlated with problematic eating attitudes and behavior, and negatively correlated with body self-image. For this study, a survey containing the 45-item Multidimensional Perfectionism Scale, the 25-item Eating Disorder Inventory and the 18-item Three Factor Eating Questionnaire was deployed to University of Maine Honors College students for a period of two weeks. Upon completion of the two-week testing period, we received 238 responses to the questionnaire. We are currently cleaning up our data and looking towards completing various tests on the data in SP2021 to determine if any significant correlations exist. The ultimate goal of this study is to put forward hypotheses related to specific components of the student lifestyle and honors curriculum that may encourage maladaptive traits for further study.

730. Monitoring Uncertainty

Submission Category: Social Sciences and Humanities

Author(s): Rose Deng

Faculty Mentor: Shawn Ell

Abstract:
Monitoring one's own knowledge and understanding, or lack thereof, can enable individuals to identify gaps in their own knowledge, in order to adaptively learn and adjust strategies to meet the demands of novel problems and tasks. Understanding how humans make decisions under uncertainty is crucial for improving pedagogical approaches that aim to support learning and transfer of knowledge. Thus, the role of uncertainty monitoring during category learning and transfer was explored. Participants learned about Chemistry concepts using one of two training methods that either required participants to respond to all task questions, or presented participants with the option of monitoring and reporting their decisional uncertainty (e.g., admitting they didn't know the answer). All participants were able to learn the concepts regardless of training method. Those who were trained to monitor their uncertainty, however, were observed to have greater performance on a novel task. These preliminary results suggest that people who actively monitor their uncertainty may be better equipped to transfer learned information to novel contexts.

731. The Effects of COVID-19 on Hospitality and Building Supply Sales in Maine

Submission Category: Social Sciences and Humanities

Author(s): Yelshaday Gebreselassie

Faculty Mentors:
- Todd Gabe
- Kathleen P. Bell

Abstract:
The COVID-19 pandemic has caused millions of deaths and resulted in large economic impacts around the world. The impacts of COVID-19 on regions and sectors of the economy, however, have been uneven. Whereas the pandemic stopped almost all tourism activity, it sparked real estate sales and construction in places that were less impacted by COVID-19.

We examine the impact of COVID-19 on hospitality and building supply sales in Maine. We analyze statewide monthly taxable sales data using a Box-Jenkins time-series model. Our empirical results show large negative impacts of COVID-19 on Maine hospitality sales. For example, hospitality sales in Maine were 64.1 percent lower than predicted in April 2020, and 35.3 percent lower than expected in July 2020. Overall, the Maine hospitality sector saw a $608 million reduction in sales between April 2020 and July 2020. Conversely, the building supply sector experienced higher than expected sales over the first five months of the COVID-19 pandemic. Building supply sales in Maine were 11.2 percent higher than expected in April 2020, and 26 percent above our forecast in July 2020. Overall, the building supply sector saw a $138.2 million increase in sales between April 2020 and July 2020.

Our results document the uneven impacts of COVID-19 on regions and sectors of Maine's economy. As Maine and other US states continue to reduce the spread and health impacts of COVID-19 and support economic recovery, knowledge of these uneven impacts offers guidance to policymakers and other decision makers as they advance policies.

732. Moose (Alces alces) in the Dawnland: Parasitic Pressures, Fragmented Management, and Sustaining Culturally Important Relationships with the Wabanaki Confederacy

Submission Category: Social Sciences and Humanities

Author(s):
- Alaina Woods
- Jason Brough
- Elizabeth Leclerc
- Steven Golieb

Faculty Mentor: Katie Glover

Abstract:
In the state of Maine, Indigenous voices, values, and ecological knowledge are not typically represented in the state's wildlife management policies, despite the implications these policies have for Wabanaki relationships with the natural world. Meanwhile, the state is adapting its management approach to contend with climate change-related increases in winter ticks (Dermacentor albipictus) that threaten to destabilize the state's population of moose (Alces alces). This emerging issue will require collaboration between state and tribal wildlife managers and provides an opportunity to redress previous failures to incorporate Indigenous concerns in the management of this iconic and culturally significant species. Here we aim to describe human-moose relationships within the Dawnland, the traditional homelands of the Wabanaki people, and provide a venue for Wabanaki voices to be heard. We outline the ecological, cultural, and political factors entangled in this issue: the role of climate change in winter tick prevalence and their threat to moose; the deep-time and ongoing relationships between Wabanaki peoples and moose; and the fraught history between the Wabanaki and settler/colonial governments. We then qualitatively assess relevant state and tribal wildlife management policies to evaluate how these management frameworks affect the ability of Wabanaki peoples to maintain and sustain their relationships with moose. This review will provide a basis for understanding the various factors underlying the issue of Indigenous representation in moose management, which we hope will support efforts to develop collaborative, complementary, and equitable management frameworks among state and tribal entities.

733. Pathfinder

Submission Category: Social Sciences and Humanities

Author(s): Tyler D'Ambrosio

Faculty Mentor: Jon Ippolito

Abstract:
Currently, 1 in every 100 adults and 1 in every 200 children in the United States suffer from Obsessive-Compulsive Disorder— that's over 2 million adults and over 500,000 children. The current primary therapy method is Exposure and Response Prevention, which introduces patients to their fears in a safe, clinical environment. The advent of the COVID-19 pandemic has created a need for an option that can be done in isolation. I am in the process of creating a digital therapy application in the form of a mobile game. The demographic will be youths aged 8-12 who have been diagnosed with, or are starting to show symptoms of, OCD. It will be able to be used as a stand-alone application, or in conjunction with conventional therapies. The intended purpose is to teach the users how their mental illness works, as well as show users how to mitigate their symptoms via in-game challenges that are analogous to real-life situations.

734. College Students Combat Period Poverty: Free Access to Menstruation Products

Submission Category: Social Sciences and Humanities

Author(s): Teresa Gallanti

Faculty Mentor: Lois-Ann Kuntz

Abstract:
Even though it costs around $10.00 a month for basic supplies for menstruation there are about 42 million menstruators that suffer from period poverty. This is the umbrella term for the inequalities related to menstruation. The emotional stress from period poverty is traumatizing due to unexpectedly starting menstruating in public without supplies (Smith, 2020). According to a recent article, individuals "who reported experiencing period poverty every month, 68% also reported symptoms consistent with moderate or severe depression, ... which linked the trend with similar ties between food insecurity and mental health" (Srikanth, 2021, p. 1). Others say they feel isolated to their homes unable to leave for work, school or civic life (Smith, 2020). This project examined how the University of Maine at Machias (UMM) could provide free menstrual products to students, and how this would impact these effects on their students. A majority of

UMM students receive financial aid for their tuition. Many of these menstruators could be affected by period poverty. Almost 20% of all individuals in Washington County live below the poverty level (U.S. Census, 2020). Details of proposing free access to campus administrators will be presented and these include: online research, interviews with period product organizations, and interviews and group discussions with Student Senate at UMM and Student Life at University of Maine (UM) and UMM. From this investigation, it was found that the costs would be negligible for UMM to provide free access even after accounting for maintenance and facility workers.

735. Abstract Moved to Another Category

736. Assessing the Role of Traditional Ecological Knowledge in Sustainable Food Systems

Submission Category: Social Sciences and Humanities

Author(s):
- Matthew James
- Douglas Hasson
- Alex Bromley
- Elise Gudde

Faculty Mentor: Gregory Zaro

Abstract:
Climate change has severe impacts on agricultural systems and the way that the world cultivates its food. In the coming years, climate models have predicted changes that are in direct relation to our food systems, including; the intensity and frequency of anomalous precipitation and drought events, increases in pests, and more frequent crop failure. Traditional ecological knowledge may have an increased value in the future, as the need for de-industrialization and increased sustainability grows, and its incorporation into contemporary farming may alleviate the negative results from these changes. The primary goal of our research asks if contemporary farmers can utilize geographically and ecologically specific practices developed by generations of indigenous peoples to help preserve their crops, farms, and livelihoods. Four case studies from various regions and indigenous groups around the world were evaluated in terms of the practicality and resilience of their agricultural and subsistence practices. Additionally, we consider how the adoption of these practices impact the indigenous group and contemporary farmers beyond economic value or crop yield.

737. The Pandemic and its Positive Impact: A Content Analysis of Media Coverage Bre Cummings, Tara Foley, Alexandra Karter & MacKenzie Nixon

Submission Category: Social Sciences and Humanities

Author(s):
- Breann Cummings
- Tara Foley
- Alexandra Karter
- Mackenzie Nixon

Faculty Mentor: Sandra L. Caron

Abstract:
In this content analysis, we chose to examine positive news stories of U.S. families coping during the pandemic. Our research focused on articles appearing in the first six months of the pandemic in the top 12 national news media outlets Yahoo News, Google News, Huffington Post, CNN, New York Times, Fox News, NBC News, The Washington Post, Wall Street Journal, USA Today, and the LA Times. Our research question was, What has the news media coverage been in terms of the positive impact of COVID-19 on children and families? More specifically we asked, What have the positive news stories focused on? A total of 314 articles were identified and analyzed. Eight major themes emerged. Our findings and conclusions will be discussed.

738. S.S. Media: Giving Researchers access to Social Media

Submission Category: Social Sciences and Humanities

Author(s):
- Ryan Handlon
- Colleen DeMaris
- Griffin Fluet
- Abdullah Karim
- James West

Faculty Mentor: Terry Yoo

Abstract:
Social media has grown to be an extremely large part of society in recent years. Because of this, a need to gather data from it has also arisen. Black Bear Analytics is creating a tool that allows

researchers to scrape public data from posts on Twitter and Instagram. This tool was requested by Doctor Judith Rosenbaum of UMaine's Department of Communication and Journalism. The S.S. Media will have an easy-to-navigate interface that allows users to switch between scraping public posts on Instagram and Twitter. The New Search page gives the user an option of either an advanced search or a basic search. The basic option searches by specified hashtags, locations, or phrases, and an acceptable start and end date to check with each post scraped, while an advanced search has the same general functions as the basic search, but adds the ability to search for more than one topic (hashtag, location, phrase), as well as run the search once every specified amount of time. The tool will store a number of scrape requests, so that users can either inspect a previous scrape request or request it again. Once the scraping is completed, the data will be downloaded to the user's computer in the form of a .csv file, and images will be stored in a corresponding folder. The outcome of this project will hopefully be that researchers like Doctor Rosenbaum can have a tool that will enable them to easily search for data and trends on social media sites.

739. Increasing Childhood Educational Attainment Through Family Resource Connections and Advocacy

Submission Category: Social Sciences and Humanities

Author(s): Ambrosia Ross

Faculty Mentor: Lois-Ann Kuntz

Abstract:
By fourth grade, 68% of American students are reading below where they should. Of these functionally illiterate students, 82% are from low-income families (30 Key Child Literacy Stats Parents Need To Be Aware Of, 2019). In Maine over 48,000 children were living in poverty (Child Wellbeing Indicators & Data, 2014; KIDS COUNT Data Center, n.d.) These children are often missing important components of education because of truancy, low literacy exposure, and the inability of parents to attend functions or meetings, due to a lack of family and community supports (McCrea, 2018; Smith, 2006). Washington County has over thirty-five family resource programs available, however each program has separate focuses and eligibility requirements. A project proposal for an Advocate position that would help families maximize their childrens' educational potential was developed. The Advocate will connect a family to specific community resources maximizing a child's educational potential. This Advocate would be assigned to provide families with help developing individualized action plans and identifying gaps in their current resource accessibility. The action planning process involves developing family goals and choosing success markers to use based on program suggestions. The Advocate will help maintain

communication between the client and the community resource programs to meet deadlines. Potential success benchmarks for this program will be discussed (Freedman, 2012). Work on this proposal included conversations with the Community Caring Collaborative non-profit organization about interest in such a position and this has resulted in a presentation of this proposal to one of their funders later this spring.

740. Supporting US Military Veterans Transitioning to Civilian Life: Exploring a New Model

Submission Category: Social Sciences and Humanities

Author(s): Carol Lane

Faculty Mentor: Lois-Ann Kuntz

Abstract:
Serving in the Armed Forces is a unique experience where strong bonds can form between peers as they experience military life's culture shock. It is becoming well known that even though help is offered, after discharge from the Armed Forces, US Veterans are overrepresented in the prison system, the homeless population, and even suicide, much of which is related to readjusting to civilian life (Elnitsky, et al, 2017). Further research suggests many of these outcomes are related to separation from peers (Castro & Truusa, 2019). To identify the reasons for this disconnect between veterans and existing veteran-help-based services, an online survey was posted to various social media boards. A sample of 59 veterans participated, and 61% reported a difficult transition to civilian life, while 40% who visited community-based outpatient clinics to seek help indicated it was unhelpful. Thousands of programs exist to help veterans; however, the annual numbers of those succumbing to trouble with transitioning remain steady or have increased. The multitude of data and research available suggests that a new approach addressing these veterans' concerns and suggestions should be considered. This proposed new model that includes a professional veteran-staffed organization with proactive peer support was favorably received by 68% of those surveyed, while 81% stated that they would volunteer for such an organization. The beneficial peer support cultivated in the services would allow our veterans to employ the skills they already possess to assist veterans in their home community potentially reducing rates of incarceration, homelessness, and suicide.

741. Cyber Victimization and Internalizing Distress: Avoidant Problem-Solving Style Moderates Depressive, but not Social Anxiety Symptoms

Submission Category: Social Sciences and Humanities

Author(s):
- Allison Marcellino
- Jade Perry
- Michelle Buffie
- Douglas Nangle

Faculty Mentor: Douglas Nangle

Abstract:
Background: Social anxiety and depression are prevalent disorders that result in substantial distress and impaired functioning among young adults. Particularly, research has suggested that there is a positive association between cyber victimization (CV), social anxiety, and depression among young adults. Social problem solving (SPS) styles, or ways in which a person attempts to understand, cope with, and find effective solutions to a problem, also have well documented relations with internalizing distress. Of interest in this study is the avoidant style (AS) social problem solving, characterized as a passive, inactive, approach that is maladaptive because it leads to the avoidance and exacerbation of problems. Research has shown that AS social problem solving is associated with symptoms of depression and anxiety. Though SPS styles have been found to be moderators of internalized distress in numerous studies (Nezu & Ronan, 1988; McCabe et al., 1999), no studies have examined their possible moderating effects on the impact of CV. While both depression and social anxiety are associated with SPS and CV, the stronger associations with depression has led to much fewer investigations exploring these relationships with social anxiety. Thus, the present study investigates the role of AS problem solving in the relationship between CV, depression, and social anxiety symptoms. We hypothesize that AS problem solving will moderate the relationship between CV and both depression and social anxiety symptoms.
Method: Undergraduate students (N = 325) aged 17-25 completed the Cyber Peer Experiences Questionnaire, Social Problem-Solving Inventory-Revised, Center for Epidemiological Studies Depression Scale-Revised, and Social Interaction Anxiety Scale.
Results: Two separate moderated regression analyses were conducted: the first examined CV and AS's relationship with depressive symptoms as the outcome and the second examined social anxiety symptoms as the outcome. CV and AS explained 28% of the variance in depressive symptoms and 18% of the variance in social anxiety symptoms. The interaction between CV and AS significantly added to the amount of variance explained for depressive symptoms ($R2\Delta = .01$,

F[1, 326] = 4.21, p = .04), but not for social anxiety symptoms (R2Δ = .00, F[1, 321] = .61, p = .44).
Discussion: As hypothesized, AS problem solving was found to be a significant moderator in the relationship between CV and depression; however, AS was not found to be a significant moderator in the relationship between CV and social anxiety. As such, it is suggested that people who are victimized online and have an avoidant problem solving style may have an increase in depressive symptoms, but not symptoms of social anxiety. These findings help characterize the nuanced relationships between SPS style, CV, and internalized distress and highlights the need for further investigation.

742. What It Was And What I Know: Attempts at Family History

Submission Category: Social Sciences and Humanities

Author(s): Katherine Reardon

Faculty Mentor: Gregory Howard

Abstract:
Family stories and family histories are contingent on how they are remembered. As these stories are passed down, the ways that they are remembered can change, with the truthful aspects of these stories disappearing over time. As a result, many family stories are not necessarily truthful, but this does not discount their value. The aim of this project is to explore these ideas while also answering the following question: to what extent are family stories bound by the 'truth'? In order to answer this question, I have explored my own family stories that I know may not be true and have told them how I remember them; ultimately telling stories that are a bit different than how other members of my family might remember them. I have done so by creating a work of creative nonfiction that is composed of small stories and vignettes that all tie into these overarching themes and attempt to answer this larger question. In doing this work, I have also explored how these stories affect me and how I fit into them; ultimately finding that it is not the truth in these stories that matters, but how we feel about them.

743. Moved to Late Breaking Abstracts

744. Talking with Children About COVID-19: A Content Analysis of National Media Coverage

Submission Category: Social Sciences and Humanities

Author(s):
- Colby Kreider
- Natalie Coleman
- Isabel Larsen
- Gabriella Miller

Faculty Mentor: Sandra Caron

Abstract:
This research project focused on how the news media has covered the topic of talking to children about COVID-19. A number of important professional organizations have released guidance for parents. We were interested in examining the extent to which news outlets have covered this guidance and what focus there has been in the news media. Our research questions included: What has the news media coverage been in terms of the importance of parents talking with their children about COVID-19? and What have the news articles focused on when discussing parents talking with their children about the pandemic? We identified 75 articles appearing in the top US news sources in the first six months of the pandemic. Seven major themes emerged. Findings and implications will be discussed.

745. Investigating Emptiness in Buddhism and Daoism

Submission Category: Social Sciences and Humanities

Author(s): Aubree Nygaard

Faculty Mentor: Hao Hong

Abstract:
This project focuses on the concept of emptiness in both Buddhism and Daoism. In particular, we look at emptiness in Buddhism as described by the Indian philosopher, Nāgārjuna, who is widely considered to be one of the most important Buddhist philosophers. In Buddhism, emptiness, or śūnyatā, refers not to non-existence, but absence. Specifically, the absence of svabhāva, usually translated as “inherent existence” or “intrinsic existence”. For something to exist with svabhāva means that it exists independently of anything else that exists. Nāgārjuna details contradictions

that arise if one believes in svabhāva. This relates to the idea of dependent origination in Buddhism, that all things come to exist dependently and a thing's existence is determined by its relations to other things. Emptiness is also a central concept in Daoism. In Daoism, the concept refers to a state of quiet and simplicity that is attributed to both the nature of the Dao and a living style in accordance with the Dao. The Dao is empty and is considered to be the source of all things. The importance of emptiness can be illustrated by the example of a clay pot: it is the empty space inside the pot that allows the pot to fulfill its function. This project analyzes the concept of emptiness in Buddhism and Daoism and explores the similarities and differences of the concept in these two traditions.

746. Mediation of the Religion Prejudice Link

Submission Category: Social Sciences and Humanities

Author(s):
- Aaron Dustin
- Sally B. Barker
- Jordan P. LaBouff

Faculty Mentor: Jordan P. LaBouff

Abstract:
Although religious teachings typically recommend prosocial behavior, religiosity is reliably linked to prejudice. This paradoxical relationship raises the question: what is it about religion that might lead to prejudice despite religion's apparent drive for prosociality? The answer may lie with religious fundamentalism, a particularly rigid way of holding one's religious beliefs as the single deepest and most certain source of truth. We propose that religious fundamentalism mediates the relationship between religiosity and prejudice. We also propose that any relationship between religious fundamentalism and prejudice will be further mediated by three facets of inflexible thinking: belief rigidity, dualism, and inviolacy.
We're going to look specifically at prejudice against Muslims in a Christian sample for several reasons: 1) Christians see Muslims as a value-violating outgroup and previous research has linked Christian religious fundamentalism to anti-Muslim prejudice, 2) prejudice against Muslims in the U.S. is fairly common, and 3) anti-Muslim prejudice in the U.S. is not as stigmatized as many other forms of prejudice making it easier to measure directly.
To test this mediation, we plan to use an online survey of an all-Christian sample (n=~232) collected at UMaine. Participants will complete measures of religiosity, prejudice against Muslims, religious fundamentalism, belief rigidity, dualism, and inviolacy. We expect that mediation analyses will show that religiosity is linked to prejudice through the mechanism of

religious fundamentalism, and that religious fundamentalism is linked to prejudice through the mechanisms of belief rigidity, dualism, and inviolacy.

Natural Sciences

Projects 801 - 868

Natural Sciences

801. Examining Remote Sensing Land Surface Temperatures in the St. Elias Range

Submission Category: Natural Sciences

Author(s): Ingalise Kindstedt
Kristin Schild
Dominic Winski
Dorothy Hall
Luke Copland
Seth Campbell
Karl Kreutz

Faculty Mentor: Karl Kreutz

Abstract:
Accurate remote sensing data are crucial for monitoring alpine warming in rugged regions with sparse in situ measurements. Here, we evaluate potential sources of a cold bias in NASA's Moderate Resolution Imaging Spectroradiometer (MODIS) land surface temperatures (LSTs) in the St. Elias Range (Yukon, Canada). We hypothesize the bias results from either MODIS' large footprint in heterogeneous alpine terrain or poorly constrained emissivity values used in the LST calculation. To test these hypotheses, we compare LST datasets with different spatial resolutions at study sites Eclipse and Divide. We also compare MODIS LSTs to MODIS brightness temperatures, which do not include the emissivity correction present in the final LST product. Differences between MODIS and in situ temperatures are largest and most variable in fall and winter. Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) temperatures are also lower than in situ, the bias persisting despite ASTER's smaller footprint. MODIS brightness temperatures show a more pronounced cold bias in fall and winter, which is not mitigated by the application of the emissivity correction. In contrast, the emissivity correction does decrease the cold bias in spring and summer brightness temperatures. Poorly constrained emissivity values thus do not fully explain bias, but they cannot be ruled out as an exacerbating factor. We suggest paired in situ measurements of emissivity and surface characteristics at sub-daily resolution to better constrain emissivity changes on short timescales. We also recommend paired in situ surface and 2 m air temperature measurements to check for a near-surface temperature inversion.

802. Mulch as a Crop Management Tool in Wild Blueberry

Submission Category: Natural Sciences

Author(s): Rebecca Gumbrewicz

Faculty Mentor: Lily Calderwood

Abstract:
Wild blueberry growers face many challenges amplified by climate change. These include new insect pests, greater fungal infections, altered pollination, and erratic weather events. Summer 2020 in Maine experienced the most severe short-term drought since the early 2000's. With an increase in drought conditions and many growers without irrigation, it is important to explore field management practices that could increase soil water holding capacity and mitigate some of these challenges. The goal of this project is to evaluate wild blueberry growth, yield, quality, pest pressure and soil moisture under four softwood mulches each with different particle sizes.
Pine mulches were applied at half an inch depth in an organic field in spring 2020. Treatments included sawdust, wood shavings, bark mulch, and wood chips. The control had no mulch applied. Soil temperature, soil moisture, pest pressure, plant chlorophyll, and plant growth were measured throughout the season. Yield and berry quality will be measured at the end of the harvest year (August 2021).
After one growing season, sawdust and wood chip treatments had the lowest mean soil moisture but had higher mean stem height and bud number per stem. All mulch treatments significantly reduced disease intensity relative to the control.
Our first-year data indicate that this depth is effective at reducing disease. In the second year of this study, berries will be harvested, and we will determine which particle size, if any, is the most viable option for farmers interested in increasing soil moisture without increasing water inputs.

803. PFAs-free Wood-based Food Serving Plates With Excellent Oil and Grease Resistance

Submission Category: Natural Sciences

Author(s): Rakibul Hossain

Faculty Mentor: Mehdi Tajvidi

Abstract:
The most common commercial method for imparting water, grease, and oil resistant properties to paper-based food serving plates is by using per or poly-fluoroalkyl substances (PFAs). Cellulose nanofibrils (CNF) and lignin-containing cellulose nanofibrils (LCNF) have been shown to have

excellent binder properties with lignocellulosic materials and they can also form excellent barrier layers to grease and oil. In this study, cost-effective, eco-friendly, and oil and grease-resistant food serving containers were made from wood flour with cellulose nanofiber coating layers on the surface. The multi-layer wet-on-wet cellulose nanofiber composite materials were developed using a vacuum filtration process. The surface, barrier, and mechanical attributes of these composites were characterized. All composites showed excellent oil and grease resistivity according to the "kit" test passing kit #12, the highest possible. The surface free energy and water contact angle showed that the composites with LCNF in the top layer were more hydrophobic than the ones coated with CNF made from bleached pulp fiber. All composites had higher flexural and tensile properties compared with commercial food containers and the mechanical properties increased with increasing binder content. Thermogravimetric analysis (TGA) showed that the rate of thermal decomposition of the composites followed a typical trend of lignocellulosic materials and they had enough thermal stability to be used for hot food serving applications. Overall, the cellulose nanofiber composites possess excellent mechanical and barrier properties and can be considered as a wood-flour-based (pulp-free) and PFA-free alternative for oil-resistant commercial food serving containers.

804. The Effects of Timber Harvesting on Ixodes Scapularis Densities and Tick-borne Pathogen Transmission in Maine

Submission Category: Natural Sciences

Author(s):
- Stephanie Hurd
- Laura Kenefic
- Jessica Leahy
- Andrew Richley
- Carly Sponarski
- Allison Gardner

Faculty Mentor: Allison Gardner

Abstract:
Lyme disease poses an immediate and expanding threat to public health, with tens of thousands of cases reported annually in the U.S. The blacklegged tick (Ixodes scapularis) is the principal vector for the bacterium that causes this disease (Borrelia burgdorferi). Many wildlife species are important hosts for I. scapularis (e.g., white-tailed deer), natural reservoirs for B. burgdorferi (e.g., white-footed mice), or both. During the vast majority of the life cycle during which the tick is not feeding on a vertebrate host, it lives in the microhabitat of leaf litter on the forest floor.

While the Lyme disease transmission cycle is deeply embedded in the forest ecosystem, limited research has investigated the effects of active forest management via timber harvesting on vector abundance and pathogen transmission. Timber harvesting alters species composition and density of trees and understory plants, potentially causing an ecological cascade in which changes in microhabitat and wildlife communities alter tick density. This study tests the specific hypotheses that different intensities of harvesting ranging along a low to high intensity gradient will affect 1) tick density, 2) understory and microhabitat features, and 3) daily deer activity. To test these hypotheses we collected ticks, deployed trail cameras to quantify large mammal presence and activity, and characterized understory and microhabitat (e.g., leaf litter depth and humidity). Our results show a significant, negative relationship between timber harvesting intensity and nymphal tick density. Our long-term goal is to develop forest management guidelines that aid in the mitigation of human-disease risk.

805. Antioxidant, Antimicrobial and Hydrophobic CNF Films as an Active Packaging Material

Submission Category: Natural Sciences

Author(s):
- SuriyaPrakaash Lakshmi Balasubramaniam
- Denise Skonberg
- Caitlin Howell
- Mehdi Tajvidi

Faculty Mentor: Denise Skonberg

Abstract:
There has been increasing concern about synthetic food packaging materials primarily due to their inability to be degraded naturally. An alternative to synthetic packaging material could be the use of natural biopolymers such as cellulose nanofibers (CNF). CNF have excellent mechanical and barrier properties. However, due to their hydrophilicity, CNF are susceptible to moisture induced deterioration of their properties. One possible way of increasing the hydrophobicity of CNF is through the modification of CNF films. Use of plant compounds with CNF can improve hydrophobicity whilst also providing additional active functionalities such as antioxidant and antimicrobial properties. In this study, premade CNF films were modified with compounds commonly found in plants. Through reaction mechanisms involving different chemical agents. The films were investigated for evidence of modification, hydrophobicity, mechanical properties, crystallinity, thermal stability, and antioxidant properties. From the results, it was evident that modification with plant compounds imparted antioxidant properties to CNF films. a maximum DPPH free radical scavenging activity of 36% was observed. A

shelf-life study on canola oil showed a decreased amount of secondary oxidation products (0.486 mg MDA/ g sample) in samples exposed to modified films when compared to controls. Similarly, all modified films showed enhanced hydrophobicity (94° water contact angle) and modification did not greatly affect the mechanical and thermal properties of the film. Therefore, modification with plant compounds has the potential to improve hydrophobicity while providing additional functionality to CNF films thereby improving their value.

806. A Comparison on the Contributions of Management Practices Regarding Intestinal Parasites in Companion and Production Pigs

Submission Category: Natural Sciences

Author(s): Kianna Dean

Faculty Mentor: Anne Lichtenwalner

Abstract:
The ownership of domestic pigs (Sus scrofa domesticus) as household pets is increasing throughout the country. Unfortunately, many individuals become pig owners without knowing the full extent of how to properly care for this species. In turn, complications may arise due to the lack of knowledge required to properly tend to their companion animals. Problems that may occur consist of a poor diet, unmanaged environment, or less than optimal health conditions due to negligence. It is common for mistakes to be made when caring for any domestic animal, but it has become more detrimental in the lives of pigs.
In the state of Maine alone, there have been concerns of pigs dying due to unknown conditions. Throughout the past 20 years, over 60 pig cases were brought to the University of Maine Cooperative Extension Veterinary Diagnostic Laboratory for diagnosis; either by necropsy, fecal evaluation or Polymerase Chain Reaction (PCR), to see what was behind the death or poor health of their animals. It turned out that many of these cadavers contained intestinal parasites. The formation of parasites within pig cadavers can be a common occurrence. Which forms the question, what could be the culprit behind multiple cases of both production and pet pigs having internal parasites? It is uncertain whether Maine pig producers using pasture methods have more cases of pigs containing parasites than those raising pigs strictly indoors. Therefore, analyzing different care methods for pigs, as well as the information obtained from the cadavers at the Veterinary Diagnostic Laboratory, will determine whether farming practices should be adjusted. To go about this project, a survey would be created for production and household pig owners in the state of Maine on how they have been raising their animals. The results of this survey, as well as the research done on the cadavers, should point us in the direction of where there are mistakes in management. Owners and handlers should consider whether their farming practices are

worthwhile or detrimental to the health of their pigs. If the adjustment of certain management practices proves to reduce the appearance of intestinal parasites; both pigs and humans can benefit from improved health.

807. Do Small Female Lobsters Produce Lower Quality Eggs?

Submission Category: Natural Sciences

Author(s):
- Alexander Ascher
- Richard Wahle
- David Fields
- Maura Niemisto

Faculty Mentor: Richard Wahle

Abstract:
In many marine invertebrates and fishes the onset of reproductive maturity is dictated by the temperature regime where they live. In the rapidly warming Gulf of Maine (GOM) the American lobster (Homarus americanus) is maturing at ever smaller sizes. In this study we investigated if the decrease in maternal body size also impacts egg quality. To investigate this question we took advantage of the strong latitudinal thermal gradient from southern New England (warmer) to the northeast Gulf of Maine (cooler) where there is a well-documented north to south gradient in maturation size for lobsters. We analyzed egg-bearing females from three thermally contrasting locations along this gradient to determine how metrics of reproductive output and egg quality vary with maternal body size and location. The data show that females in the south are smaller and less fecund, but at a given size there are no significant differences in fecundity among the 3 locations. The relationship between individual egg metrics and body size vary latitudinally, with egg size and caloric content significantly related to body size in northern, but not southern locations. Space-for-time comparisons such as this help us more clearly understand how climate change may impact the reproductive performance of this iconic species in the future.

808. Evaluating Sustainability Metrics For River Herring Populations During Restoration

Submission Category: Natural Sciences

Author(s): Margaret Campbell
Faculty Mentor: Justin Stevens

Abstract:
Sustainable River Herring fisheries management in Maine is pursued with a complex process involving local, state, and federal governments. Sustainability is evaluated with metrics on demographics that capture the complexities of the species' life history. We analyzed metrics of sustainability for River Herring in two watersheds in the Penobscot River under active restoration. Blackman Stream is a 688 hectare watershed with unobstructed access to the ocean; the remaining Penobscot River (~10,000 hectares) is controlled by passage at a mainstem dam in Milford. We determined annual species population abundance, age distribution, and rates of iteroparity for each watershed. In addition, we developed cohort specific return rates to compute a stock-recruitment relationship for these runs. At Blackman Stream stocking between 4,000-7,000 fish annually has resulted in runs with returns of 500,000 Alewives, for a return ratio range of over 50 to 1. In contrast, Milford has been stocked annually with 30- 40,000 fish, which has resulted in returns around one million Alewives. At Milford, return ratios have fallen from a maximum of 53 to 1 for the 2011 cohort to 3 to 1 for the 2015 cohort. Blackman Stream was composed of >99% Alewives, whereas the proportions of Blueback Herring at Milford varied from 20-50% yearly. The age distribution consisted mainly of age three and four, however, there has been an increase in older fish in later years at both locations and for both species. The iteroparity rates at Milford for Alewives has increased from 10% to 40% of the run, and Blueback Herring has increased from 5% to over 25% of the run. At Blackman, the Alewife iteroparity rates have gone from ~20% to ~45% of the run. These data demonstrate the complexities of management of a species with varied life history and implies the need for consistent, long-term sampling to describe stock demographics. For example, in Milford, the sampling from 2014 to 2020 only captured complete cohort data for the 2011 to 2014 cohorts. This analysis provides for a baseline for these restoring runs and allow for tracking sustainability which will help protect and understand this and other fisheries in the future.

809. Ideal Conditions for Cryptosporidium Attachment and Infection

Submission Category: Natural Sciences

Author(s):
- Emily Pierce
- Sarah Hosler

Faculty Mentor: Sue Ishaq

Abstract
Cryptosporidium sp. a free-living protozoon, will attack the ileo-cecal valve of the mammalian intestines when ingested. It is unknown why it attacks this valve specifically, but may be from lack of microbial competition in this area. This research study aims to identify any key microbial players, or lack thereof, that encourage the infection of Cryptosporidium sp. at the ileo-cecal valve. Multiple biopsy samples of cow intestine tissue and microbiota will be collected and co-cultured. Once mammalian cells have acclimated, Cryptosporidium sp. will be added to these plates with and without the presence of gut bacteria, to observe infection patterns. Additionally, the microbial players in each sample will be taken and the identity of missing players will be noted. If a key player is in fact missing that allows Cryptosporidium sp. to attach, it is possible that a dietary supplement or additive could be created to reduce the chance of animals getting infected.

810. Human Facial Recognition in Holstein Heifers

Submission Category: Natural Sciences

Author(s): Kendra Huth

Faculty Mentor: David Marcinkowski

Abstract:
Cattle see things differently than humans, but it's known that cattle can identify humans based on past encounters. This study examined the ability of cattle to recognize humans solely based on their faces. Six Holstein heifers from J.F. Witter Teaching and Research Farm were trained and tested for 4 weeks using pictures of objects and faces, which the cattle have never seen. A fifth week of testing took place 6 weeks later to examine their long-term memory. Each heifer participated in 10 trials per day using a Y-maze configuration, with 2 photo options to choose from. The heifer received approximately 1/2 cup of sweet calf grain if they chose correctly. Week 1 compared a blank, white paper and Caucasian face. Week 2 compared a tree trunk and Caucasian face. Weeks 3–5 compared the African American and Caucasian faces. The correct picture was occasionally illuminated with a portable light to help the heifers focus. Data was analyzed with IBM SPSS statistical software, using Chi square procedures to compare the correct choices by heifer, week, and presence of light. Results showed that the heifers' choices improved significantly by week ($p=0.007$) and with the use of the light ($p=0.013$). The percent correct varied greatly between heifers, ranging from 50% to 80%. One heifer often displayed an 80% success rate with and without the light, supporting the hypothesis. This suggests that Holstein heifers can differentiate solely between human faces, but it depends on their individual focus levels.

811. Predicting Range Shifts for the Virginia Opossum Based on Climate Change

Submission Category: Natural Sciences

Author(s): Sara Griffin

Faculty Mentor: Danielle Levesque

Abstracts:
Climate change and human expansion are increasingly influencing species distribution and movement. The Virginia opossum has historically been observed expanding their range northward due to the warming temperatures and urbanization. I constructed a model predicting the movement of the Virginia opossum northward into central Maine and beyond, based on current climate change predictions. We estimated that the Virginia opossums' northern range is restricted by two abiotic winter factors, snow cover and low temperatures, which prevents foraging and ultimately leads to starvation. For this study, ambient forest temperatures were recorded using biologgers and prediction models for snow cover and temperature are used to predict the movement and establishment of stable opossum populations. The model predicts that central and northern Maine's climate will continue to become favorable for stable populations of the Virginia opossum and that the establishment of more suburban areas will positively affect the species' expansion. As a new addition to the biodiversity of central Maine, the opossum's impact on the environment is important to understand. Understanding the physiology of species helps predict the effects an animal will have on an environment. It is determined that the Virginia opossum can be a vector of disease. The species also has the capacity of benefiting new environments by being an impactful prey, a predator of ticks, and being hunted. Predictions of species distribution can be beneficial in understanding species' movement and environmental impact early on due to the rapid rate of climate change and urbanization.

812. Assessment of Potential Measures of Harbor Seal Pup Rehabilitation Success at Admit

Submission Category: Natural Sciences

Author(s): Shannon Brown

Faculty Mentor: Kristina Cammen

Abstract:
Harbor seals frequently strand along the northeast coast of the United States due to injury, illness, disease, and human interaction. In Maine, a non-profit organization, Marine Mammals of

Maine (MMoME), is federally authorized to respond to these stranded animals and provide short- and long-term rehabilitation, with the ultimate aim to release the seals back into the wild. I investigated the role of multiple potential measures of marine mammal health that are evaluated at admit in determining rehabilitation success of dependent and weaned harbor seal pups from 2016 to 2019. The variables assessed were the day of the year the patients were first observed in the field, the amount of time they were observed in the field before collection, findings of human interaction, age class, weight:length ratio, and 43 blood parameters. This analysis found that pups have a greater likelihood of being released if they strand later on in the year ($p<0.05$). The longer an individual is in rehabilitation, the more likely they are to be released ($p<0.0001$). Pups that were transferred from MMoME to another rehabilitation facility had a greater likelihood of being released ($p<0.05$). Harbor seals that stranded when they were dependent pups were more likely to be released than weaned pups ($p<0.05$). Pups with a lower lymphocyte concentration at admit ($p<0.001$) and a higher total protein concentration ($p<0.05$) were more likely to be released. These findings may help rehabilitation organizations determine which harbor seal pups will be good candidates for a successful rehabilitation early on in the process.

813. Investigating Changes in the Subcutaneous White Adipose Tissue (scWAT) Proteome in Response to Cold Exposure

Submission Category: Natural Sciences

Author(s):
- Dylan Taplin
- Cory Johnson

Faculty Mentor: Kristy Townsend

Abstract:
Obesity and its co-morbidities are a prevalent and proliferating problem worldwide, especially in the United States, where the CDC reports 4 in every 10 people are obese. Addressing this epidemic requires a deeper understanding of how our body stores and utilizes fuel. The largest contributor to obesity is an imbalance in energy intake versus energy expenditure, resulting in more energy stored as fuel in the lipid droplets of adipocyes. Energy balance is regulated through modifying energy expenditure (e.g., adaptive thermogenesis) and energy intake (including appetite). White adipose tissue (WAT) is specialized for storage of fuel, whereas a second type of fat tissue, brown adipose tissue (BAT), contains dense mitochondria specialized for thermogenesis and numerous smaller lipid droplets. Therefore, BAT mainly functions to burn calories and create heat through non-shivering thermogenesis (NST). WAT depots can transform into a more brown phenotype with “beige” adipocytes that resemble BAT adipocytes, through a

process called “browning”. Additionally, de novo brown adipogenesis can also contribute to browning in WAT. One way WAT browning is initiated is through the peripheral nervous system (PNS), and release of the sympathetic neurotransmitter norepinephrine. WAT is densely innervated by sympathetic nerves, which can modulate the cellular makeup and function of their local environment in the tissue. Sympathetic nerve release of norepinephrine not only can stimulate browning, but also can promote thermogenesis itself, as well as release of lipid fuels through the process of lipolysis. Activation of the sympathetic nervous system can be accomplished through cold exposure, a potent stimuli for browning, thermogenesis, and lipolysis in WAT. Previous studies have shown that cold exposure invokes the browning phenotype in mouse subcutaneous WAT (scWAT), including local modulation of the immune cell population and promotion of peripheral nerve remodeling in scWAT. Jumpstarting the browning process has become a putative point of intervention to treat obesity, given its metabolically healthy outcomes, but the molecular mechanisms that support this transition in the tissue are understudied. Therefore, we conducted a novel proteomics experiment compare in an unbiased way the changes in protein levels as animals transition from room temperature to 24hrs of cold or 72hrs of cold. We revealed important coordinated changes in mitochondrial proteins, immune proteins, and neural system proteins that may reveal novel targets for obesity therapeutics.

814. Biophysical and Social Drivers of Tick Exposure Risk Due to Climate Change in Maine

Submission Category: Natural Sciences

Author(s): Brittany Schappach

Faculty Mentor: Allison Gardner

Abstract:
Climate change is an ongoing global issue, and in Maine, increased annual mean temperatures, decreased snowfall, and warming winters are being recorded. These changes in climate have likely contributed to the increased densities of blacklegged ticks (Ixodes scapularis) and expansion into novel areas in Maine. This range expansion has resulted in an increase in reported cases of tickborne disease such as of Lyme disease, anaplasmosis, and babesiosis across the state. Since blacklegged ticks are expanding into novel areas, there are currently at-risk populations that may lack knowledge of tickborne disease prevention. To prevent increased tickborne disease cases, this study aims to determine different Maine winter conditions and their effects on tick survival, identify current pathogen presence through small mammal trapping, and pilot an educational focus group about ticks and personal protection measures. To identify abiotic factors that limit blacklegged tick expansion, we are monitoring an outdoor tick overwintering enclosure

in Orono from November – May 2021 to assess monthly tick mortality and hourly temperatures and using indoor temperature-controlled experiments to explore the effects of temperature variance on tick mortality. Current pathogen presence will be determined by collecting tissue biopsies of small mammals across the state. Lastly, we will use a One Health framework to facilitate a pilot focus group to educate the gaps in knowledge and behaviors of an at-risk population in Maine. These aims will provide insight for more accurate tick expansion prediction models, current pathogen presence in the state, and determine risk assessment and provide education of at-risk populations.

815. Estimating the Cost and Break-even Point of a Small-scale Timber Harvesting Operation

Submission Category: Natural Sciences

Author(s): Ashish Alex

Faculty Mentor: Anil Raj Kizha

Abstract:
Economic feasibility of small-scale timber harvesting operations is restricted mainly due to low volume timber production and limited area of landholdings. These restrictions make it necessary to assess the economic feasibility based on the market condition, species, and volume to be harvested, before the initiation of the operation. Break-even analysis is an essential tool that provides the assessment for the forest managers to plan the harvesting operation. The objectives of this study were 1) to estimate the break-even point (no net loss or gain) of the operation through break-even analysis and 2) to estimate the cost of a small-scale non-industrial operation and compare the cost to an industrial scale operation if same equipment were used. The harvesting site was 9.3 ha and was harvested using tree-length method. Equipment information was collected to calculate hourly machine cost using standard machine rate calculations. Break-even point for the non-industrial operation was 925 tons and $ 49,242. The cost of harvesting timber for the non-industrial operation using chainsaw and cable skidder were 2.99 and 142.71 $ m-3 respectively, whereas the industrial operation cost for the same were 4.43 and 49.48 $ m-3, respectively. Utilization percentage and labor charge were the major factors that contributed for the difference in the cost of non-industrial and industrial operations. The study will enable natural resource managers/foresters to take informed decision making and highlights the importance of utilization percentage for limited revenue generating forest operation scenarios.

816. Breaking Down "Harassment" to Characterize Trends in Human Interaction Cases in Maine's Pinnipeds

Submission Category: Natural Sciences

Author(s): Emma Newcomb

Faculty Mentor: Kristina Cammen

Abstract:
For hundreds of years the state of Maine has been home to pinniped populations. While these populations experienced heavy pressure from humans, they became federally protected under the Marine Mammal Protection Act in 1972. The Act ultimately included language to create the Marine Mammal Health and Stranding Response Program. This program has allowed for stranding networks to form to respond to stranded animals and collect data from these animals. Long term datasets have been produced by these stranding networks, providing a valuable resource for studying patterns and trends in marine mammal health. I utilized these datasets for my analysis of stranding trends and human interaction (HI) occurrences using data collected from stranded harbor (Phoca vitulina), harp (Pagophilus groenlandicus) and gray (Halichoerus grypus) seals from 2007 to 2019 in Maine. As part of this analysis, I developed a new classification scheme for defining HI, which focuses on breaking down harassment based on the type of harassment and the risks that come with it. HI, and harassment in particular, presents a multitude of problems that affect pinnipeds on both an individual and population scale, while also presenting a risk to humans who interact with these mammals. This analysis will provide insight into where and which HI is occurring in Maine, helping us inform stranding networks on where to focus effort in mitigating human interaction, as well as how strandings and human interaction impact marine mammal health and larger trends relate to global patterns.

817. Environmental and Social Factors of Mosquito Abundance and Species Distribution Across a Land-Use Gradient

Submission Category: Natural Sciences

Author(s): Megan Schierer

Faculty Mentor: Allison Gardner

Abstract:
Mosquitoes transmit disease and pose a nuisance globally. At the landscape scale, land-use type and human behavior drive mosquito abundance and species distribution, affecting the risk of mosquito-borne disease to humans in a geographic area. Cases of mosquito-borne disease are increasing in incidence in the Northeast U.S., and the integration of ecological and social variables to understand mosquito distribution patterns is valuable but under-utilized. Using a One Health framework, this research will assess environmental and human behavioral dimensions of mosquito distribution and human exposure risk to mosquitoes across an abrupt urban to rural gradient in Bangor, Maine. Land-use categories will be established from an existing city zoning map. Property addresses will be randomly selected for participant recruitment from each residential land-use type. To identify human knowledge and perceptions that drive behaviors surrounding mosquitoes, property-owners will complete a Knowledge, Attitudes, and Practices (KAP) survey. To define mosquito abundance and distribution across the urban to rural gradient, we will use diverse trapping techniques to collect adult and juvenile mosquitoes at participant properties and parks. We hypothesize that mosquito species distribution will vary across the gradient, with higher abundance of disease vector species in the urban land-use categories. We also expect that there will be a spatial relationship between the abundance of mosquitoes on a property and the associated property-owner KAP survey score. Through integration of ecological and human dimensions of mosquito distribution, we will define disease risk across the gradient and inform public health education efforts.

818. Assessing Animal Research During the COVID-19 Pandemic: A Literature Review

Submission Category: Natural Sciences

Author(s): Aidan Redding

Faculty Mentor: Anne Lichtenwalner

Abstract:
Due to the emergence of SARS-CoV-2, (COVID-19), rapid and thorough investigation is needed to understand how this zoonotic disease spreads, and its animal reservoirs. I hypothesize that people have become more hostile towards animals confirmed to be carriers or susceptible hosts.

A literature review evaluated research on detection of COVID-19 in animals: including susceptibility, reservoir potential, and which species facilitate transmission to people. In addition, I generated surveys for animal shelters, groomers, and boarding facilities about client and staff behavior, and changes in business. I selected businesses in East Coast states, and emailed them the IRB-approved survey.

I evaluated 59 publications published between September 2020 and March 2021. The distribution list included 240 animal-support industry contacts, with 24 survey respondents.

Research is still emerging on animal hosts and transmission. Feline species and rodents can get the disease, but not transmit it to people. Most farm animals, besides ruminants and canines, have not been shown to get infected. The important early sources were bats and pangolins. Mink and ferrets can get and spread COVID-19 (are zoonotic), but prevalence is not clear.
From the survey, no attitude changes other than increased caution were seen. Increased hostility towards animals was not detected, and no hostility towards potential vectors nor reservoir hosts, other than mink slaughter, was seen.

Based on my survey paired with my review, there has not been an obvious increase in hostility toward any animals, or towards those considered to be zoonotic hosts. However, this data is still inconclusive.
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819. The Effects of COVID-19 on Large Animal Veterinary Practices in Maine

Submission Category: Natural Sciences

Author(s): Isabelle Fernald

Faculty Mentor: Sue Ishaq

Abstract:
In this Capstone project, we investigated how the SARS-CoV-2 (COVID-19) pandemic affected large animal veterinary practices in the state of Maine. To investigate the impact of the pandemic on large animal veterinary clinics, there was an International Review Board approved survey to give to large animal veterinary practices in the state of Maine to collect information about veterinarians' experiences during the pandemic and a veterinarian's perspective on how their clients were affected.
We anticipated that veterinary practices had to change protocols involving veterinary practice and client communication and the overall interactions between the two groups. The primary focus was to find out how veterinary practices had to change to keep their clients and animals safe during the COVID-19 pandemic. By the end of the survey, we only got a few responses so we could not do any statistical analysis. However, we are going to look at the results to see how different large animal veterinary clinics reacted to COVID-19 and what they did differently. Additionally, we are going to look into how we could have improved the survey to get more responses and what could we do differently in the future. We anticipated the COVID-19 pandemic had an overall negative impact or if there were some positive impacts on the practices/farms (like an improvement on biosecurity). In addition to the overall negative impact, we anticipated that there were possible positive impacts of the pandemic like improving protocols in the veterinary clinic and on-call.

820. Genetic Analysis of Yellowtail (Seriola lalandi) for Aquaculture in Maine

Submission Category: Natural Sciences

Author(s): Sydney Avena

Faculty Mentor: Kristina Cammen

Abstract:
Aquaculture is a growing industry in Maine, and identifying new species with potential for aquaculture is crucial for its continuing success. The University of Maine's Center for Cooperative Aquaculture Research (CCAR) currently holds a stock of California yellowtail (Seriola lalandi). Similar in taste to tuna or mackerel, yellowtail are wild-caught as well as aquacultured in net pens and recirculating aquaculture systems worldwide. The fish presently at CCAR originally came from Great Bay Aquaculture and their genetic makeup is unknown. Recent research on S. lalandi suggests that this circumglobal fish has enough genetic difference between populations in the Northeast Pacific, Northwest Pacific, and the Southern hemisphere to classify them as three distinct species. In this study, three fin clips and one muscle sample were taken from three individuals for DNA analysis. PCR amplification was performed for the mitochondrial control region and two nuclear genes (RAG2 and EHHADH). The results were sequenced and compared to published sequences for yellowtail stocks in the Northeast Pacific, Northwest Pacific, and the Southern hemisphere. This analysis found that there were at least two genetically distinct stocks in the population at CCAR, with two individuals matching published sequences from the Northeast Pacific clade and one individual matching published sequences from the Southern hemisphere clade, with higher variability in the mitochondrial haplotypes compared to the nuclear sequences. By understanding the genetic makeup of the yellowtail housed at CCAR, future genetic and physiological studies can be done to determine which stock of fish is better suited to aquaculture.

821. Aquaculture Site Selection Through Dynamic Energy Budget Models Coupled With High-resolution Satellite Products

Submission Category: Natural Sciences

Author(s):

- Thomas Kiffney
- Gabe Hesketh
- Binbin Jiang
- Emmanuel Boss

Faculty Mentor: Damian Brady

Abstract:
Starting a successful aquaculture business requires careful site selection and knowledge of the location's environmental qualities. Oceanographic parameters of food (phytoplankton or suspended organic matter) and temperature control bivalve growth. Poor site selection can result in slow growth that delays the time it takes to get a product to market. The tools and methods that are required to easily match the right species with the right location are often expensive and beyond the reach of a farmer to collect alone. The Surface Biology and Geology Group at NASA identified aquaculture farm siting and monitoring as a research area with high unmet needs as well as potential value to the industry. While valuable to the entire U.S. aquaculture industry, an increased capacity for coast-wide monitoring at a fine spatial scale is critically important in Maine due to its convoluted coastline and the suite of emerging shellfish industries. This project aims to couple coastal high-resolution satellite data from Landsat 8 and Sentinel 2A/B with dynamic energy budget (DEB) bivalve growth models to identify potential sites for expansion of eastern oyster, an established industry, and scallop aquaculture, an emerging industry. The high spatial resolution as well as short revisit times of these satellites offer unprecedented farm scale site characterization reducing the barriers for expansion of scallop and oyster aquaculture in Maine.

822. Implications of Social Media in Nursing

Submission Category: Natural Sciences

Author(s):
- Courtney Benson
- Trevor Barry
- Candace Doughty
- Kristina Glynn

Faculty Mentor: Valerie Herbert

Abstract:
Nurses have the ability to use social media to communicate with health professionals, continue education, obtain up to date information, and share their experiences, but behaviors such as sharing photographs and information of patients on social media challenge the proper use in the healthcare setting (Demiray, 2019). Among nurses who use social media, does the implementation of a HIPAA-educational program, compared to nurses who did not receive HIPAA-education, reduce the incidence of inappropriate use of social media? The aim of this

review is to identify breaches in patient confidentiality, reduce HIPAA violations, and explore ways to educate healthcare professionals on proper social media usage.

Methods or Process

Using the CINHAL database on the University of Maine Folger library website, evidence based articles were found using the phrases: social media use and nursing, social media and HIPAA violations and social media in healthcare. A total of 193 articles were found, ten were used in research of this topic. Articles were selected based on significance to the topic and relevance to the PICO question.

Outcome of the Project

After reviewing the literature, interventions in the workplace, such as staff education events and clear expectations set by senior leaders, may reduce the inappropriate use of social media in nursing and reduce the number of HIPAA violations. Further research is needed to determine the most effective education method to decrease such violations.

823. Assessing Gastropods as Parasite Vectors: Problem and Prevention on Maine Farms

Submission Category: Natural Sciences

Author(s):

- Rachel White
- Tuuli Overturf
- Laura Freudenberger

Faculty Mentor: Anne Lichtenwalner

Abstract:

Vectors capable of causing disease are a rising global One Health problem; gastropods that act as intermediate hosts for parasites are no exception. Parasites such as rat lungworm (*Angiostrongylus cantonensis*) and meningeal worm (*Parelaphostrongylus tenuis; P.tenuis*) are deadly gastropod-borne parasites of humans and livestock, respectively. In areas where wildlife habitat overlaps with livestock grazing areas, risk for gastropod-born parasite transmission increases. These parasite- related health issues cause economic and management consequences for farmers, wildlife managers, and public health officials. The purpose of this research is to identify the diversity of parasites within gastropods across agricultural landscapes in Maine, and to reveal the dynamics of parasite transmission between wild and domestic animals via terrestrial gastropod vectors. In a preliminary effort to document *P.tenuis* on two sheep farms, gastropods, livestock feces and white-tailed deer feces were collected and examined for *P.tenuis* larvae. Findings suggest that *P.tenuis* prevalence in Maine is consistent with the literature (around 4%). Our lab investigates prevention methods to mitigate the risk of gastropod-borne parasite incidence in livestock. Pastured poultry, such as ducks, will be examined for effectiveness of gastropod control, and to evaluate whether birds become ill from, or effectively digest, *P.tenuis* larvae. Herbs are being investigated as a natural deterrent for gastropods. Lastly, mowing treatment to limit gastropod population numbers will be explored. Our work will determine the

prevalence of gastropod-borne parasites on Maine farms and present sustainable solutions for the control of this problem.

824. Post-Surgical Pain Management : Non-Pharmacological vs. Pharmacological

Submission Category: Natural Sciences

Author(s):
- Kendall Brown
- Elyse Good
- Samantha Dauphinee
- Kelly Goodall

Faculty Mentor: Valerie Herbert

Abstract:
Topic/Purpose:
The purpose of this literature review is to compare the effectiveness of pharmacological versus non pharmacological therapy in relation to management of post-surgical pain in the adult population.

Methods:
Using the CINAHL database and Google Scholar, we searched for scholarly, peer reviewed, and evidence based practice articles related to pain management postoperatively. The articles include benefits and consequences of pharmacological and non-pharmacological pain interventions. To conduct our search, we used phrases such as: pain management in post-surgical patients, pharmacological management in post-surgical patients, and non-pharmacological pain management in post-surgical patients. A total of eighteen research articles were found before narrowing our search to include: articles published within the past five years, and that more directly pertained to our topic and purpose of research. Twelve of these selected articles were found related to postoperative pain management in the adult population. As a group, we created a list of the major themes found in each article. The themes were compared and summarized into three major ideas including recommendations.

Conclusion:
After summarizing the topics of each article, we found three major themes related to postoperative pain management in the adult population. The themes are as follows: (a) poorly controlled pain leads to poorer patient outcomes, (b) opioids continue to be considered “gold standard” for postoperative pain management despite various physical side effects and misuse potential-- variation in standards should be considered, and (c) implementing a multimodal

approach using opioids and non pharmacological pain management may have a benefit on patient outcomes.

825. Detection of Stable Subgroups Among Dynamic Microbial Communities

Submission Category: Natural Sciences

Author(s): Steven Allers

Faculty Mentor: Benjamin King

Abstract:
The composition of microbial communities can be dynamic depending on environmental or other perturbations. Detection of microbiome community composition change has many diagnostic applications and is a focus of much current research. Here, we describe development of 'Shannon entropy based Uniformity Change' analysis, (SUC); an extrapolation of the Shannon evenness index. The idea is to take a series of Shannon evenness indices of subgroups of taxa over time, and use these indices to quickly and easily quantify a single numeric representation of a subgroup's 'stability'. In other words, measure the extent to which the evenness of a distribution changes for a subgroup; rather than, as done traditionally, focus mainly on whether the distribution, itself, is even. Identification, and or quantification, of stability of sub-groups in different times and conditions may give various insights; for instance, in the case of microbiomes, interdependent communities might be found, or the degree of their interdependence graded by the relative stability these groups create. The novelty of such an analysis need not necessarily be in its exactness; as there is an implicit benefit in the ease and simplicity of the Shannon entropy formula itself, which allows quick computations compared to, for instance, methods which aim to find groups by calculating and determine 'true' change over stochiatric noise. Consequently, we believe the usefulness of this tool may be largely based on its ability to quickly identify potential novel sub-groups, and this is a future focus; wherein different avenues such as machine learning will be considered for initial grouping and improvement of group selections, which, currently, are lacking.

826. Detection and Survival of Listeria Monocytogenes on Seaweed (Sugar Kelp) During Storage

Submission Category: Natural Sciences
Author(s):

- Samuel Akomea-Frempong

- Denise I. Skonberg

Faculty Mentor: Jennifer Perry

Abstract:
Occasional pathogenic contaminants of fresh produce such as Listeria monocytogenes can present a serious health risks in minimally processed vegetables including sugar kelp (Laminaria saccharina). Although kelps have some antimicrobial potential, they can also harbor pathogens due to their rich nutritional composition and high moisture content. The aim of this study was to evaluate the survival of L. monocytogenes on sugar kelp during post-harvest storage.
Sugar kelp (whole blade and shredded slaw) was inoculated with 6.0 log CFU/g of two strains of L. monocytogenes. Samples were sealed in bags either with or without vacuum and stored at ~4°C and 22°C for up to 7 days. Microbiological analyses were performed daily using FDA-BAM standard protocols. One-way ANOVA ($p<0.05$) was performed to evaluate effects of the kelp form and storage temperature on pathogen survival.
L. monocytogenes populations were reduced by 3 log CFU from 5.5 to 2.2 log CFU/g for whole blades and from 5.5 to 2.7 log CFU/g for shredded slaw at one-hour post-inoculation and before refrigerated storage. L. monocytogenes populations on kelp were below enumerable limit (10 CFU/g) from day 1 through day 7 of refrigerated storage. However, L. monocytogenes was detected on kelp samples during storage when subjected to microbial enrichment protocols.
The reduction in L. monocytogenes counts to below enumerable limits during storage suggests the bacteriostatic nature of sugar kelp but results from the enrichment study imply the need to optimize postharvest processing practices to enhance the safety of sugar kelp.

827. Physicochemical Analysis and Effects of Processing on North Atlantic Squid Species

Submission Category: Natural Sciences

Author(s):
- Caitlin Hillery
- Brianna Hughes

Faculty Mentor: Denise Skonberg

Abstract:
The primary objective of this research is to characterize compositional differences between two North Atlantic squid species, Illex illecebrosus and Doryteuthis pealeii, based on their edible portions: mantles and tentacles. Other objectives include determining quality differences between unfinished product—whole squid—and processed product—cleaned, brined, and refrozen

mantles and tentacles; and comparing the compositional impacts of two different freezing methods (plate feeding at sea vs. blast freezing on land) on the squid. Moisture content, fat content by acid hydrolysis, and salt-soluble protein and ash contents were determined through standard methods following dissection and homogenization of squid subsamples. Instrumental color will be evaluated using a Hunterlab colorimeter to determine L*a*b* values, and in-vitro protein digestibility will be performed on freeze-dried mantle and tentacle samples using pepsin and trypsin; water-holding capacity will also be determined by a centrifugation procedure. The effects of all independent variables will be analyzed statistically with ANOVA, with $p < 0.05$. Analyses are ongoing; however, moisture analysis has indicated that samples blast-frozen on land exhibit slightly higher moisture contents than their plate-frozen counterparts, and lipid analysis has suggested that Illex illecebrosus are slightly lower in fat than Doryteuthis pealeii. These squid are the only two species in the world that have been certified sustainable by the Marine Stewardship Council, and this research will allow fisheries to insure product quality and provide more detailed dietary information to consumers and markets around the world, fostering interest in this healthy, sustainable protein source.

828. Streamflow Change and Potential Impact on Australian Indigenous Water Values

Submission Category: Natural Sciences

Author(s): Rachel Coleman

Faculty Mentor: Shaleen Jain

Abstract:
Trends in Australian streamflows have been observed to be changing over the last few decades which can compromise marginalised populations' resilience to water stress due to limited access to resources that are more abundant to non-marginalised populations. Resilience to water stress can also be undermined through violation of cultural water values since the offenses erode sense of self-identity, community, and culture.
Modelled historical daily streamflow data spanning 39 years (1980-2019) at 35 Australian streamflow locations was averaged over 5 days and then sampled 1,000 times to generate a comparison distribution for each day at tau levels 0.2, 0.5 (median), and 0.8. Quantile regressions with no-cross provisions were then employed for the averaged actual streamflow values against the sample distribution at each tau. Next, streamflow results were compared against a framework of Indigenous water values developed through identification of hydrological themes visible in literature and 22 available Indigenous seasonal calendars.
Themes identified within literature of Indigenous hydrological values included risk assessment, resource availability, caring for land, and honouring traditions. Trend analysis of daily

streamflow volume changes found significant decreases of both peak and low streamflow in New South Wales and Victoria, a mix of significant declines and increases across Western Australia and Queensland, while the Northern Territory had mostly significant increases in peak and low streamflow volume. Potential challenges to Indigenous water values varied in degree and direction through the year, indicating that efforts to mitigate potential impacts should be tailored to the location with Indigenous co-management.

829. Using Different Aerial Imagery Platforms to Assess Marine Debris and its Relationship to Island-Nesting Seabirds

Submission Category: Natural Sciences

Author(s):
- Lauren Maher
- Meredith Lewis
- Logan Kline
- Cynthia Loftin
- Aly McKnight

Faculty Mentor: Cynthia Loftin

Abstract:
Persistent marine debris accumulation along the North Atlantic coast negatively affects marine ecosystems. Identifying marine debris in aerial imagery can be an effective method to estimate quantities and patterns of accumulation and distribution. This data can lead to a better understanding of how debris may affect seabird abundance, distribution, and behavior on nesting islands. Aerial images are also important for ecological studies as they provide a record of nesting seabirds on islands that may otherwise not be accessible on foot or have restricted seasonal access. I identified, mapped, and estimated the types and volume of marine debris on two of Maine's coastal islands to evaluate relationships between debris and seabird nesting patterns. I used digital imagery captured by plane-based and Unoccupied Aerial Vehicle (UAV) cameras during the 2019 and 2020 nesting seasons. UAV imagery typically has higher resolution data than plane-based imagery, which may result in fewer omission errors, but can cause disturbances. I analyzed both plane-based and UAV-based imagery with ArcGIS Pro to evaluate this discrepancy. I quantified marine debris, particularly lobster traps and buoys, as well as assessed seabird abundance and integration with debris in order to evaluate the correlation debris presence and quantity may have with seabird behavior. This protocol provides a dataset that quantifies marine debris and how its abundance can upset marine wildlife and coastal ecosystems.

830. Dulse Nursery

Submission Category: Natural Sciences

Author(s):
- Kiera Luu
- Luz Kogson

Faculty Mentor: Tim Bowden

Abstract:
Dulse Palmaria palmata is a red macroalgae native to intertidal regions of the northern Atlantic. It is one of the favorite foods of the Gulf of Maine native species green sea urchin Strongylocentrotus droebachiensis. This sea urchin is aquacultured at UMaine's Center for Cooperative Aquaculture Research (CCAR) by Luz Kogson M.Sc. While most dulse in Maine is collected from the wild, sea farms such as Maine Sea Farms and Springtide seaweed have cultured it on longlines. These methods require harvesting licenses and farming permits and often involve processing and drying for human consumption. When the sea urchins were fed macroalgae, it was harvested by hand from the water. We established a dulse tumble culture system within the urchin lab at CCAR to provide a constant and accessible source. Tumbling culture is a method of algae culture that uses aeration to encourage growth. Our method was very low-maintenance with water exchanged and fertilizer added only once a week. Mass and salinity of the cultivars were assessed biweekly. At the completion of the 113 day trial, we found that all cultivars had over a 1000% increase in growth by mass. Based on the positive growth rates, we believe that growing dulse in lab tumble cultures is a reliable and efficient approach to having fresh food on hand for aquacultured species like sea urchins. However, this was a very small scale trial and future trials are necessary to determine whether this method is applicable and cost effective in larger scale operations.

831. Using Local Ecological Knowledge to Describe Estuarine Use Patterns and Inform Community Management of Shellfish

Submission Category: Natural Sciences

Author(s):
- Sara Swett
- Sarah Risley
- Melissa Britsch

Faculty Mentor: Heather Leslie

Abstract:
Local ecological knowledge (LEK) is considered an untapped source of knowledge and can be used in addition to scientific ecological knowledge (SEK) to fill data gaps and help inform fisheries and ecosystem management. The focus of this project was to describe patterns of recreational use and shellfish presence on the Damariscotta and Medomak river estuaries in Maine with LEK collected using maps and semi-structured interviews. This participatory mapping (PM) study started in 2020 and is led by University of Maine graduate students Melissa Britsch and Sarah Risley. This project addresses the following questions: 1) Which areas are most important for multiple river user groups? 2) What type of activities take place on the rivers and where? 3) Which areas have low or high shellfish abundance? and 4) The analysis aimed to determine areas of high shellfish abundance, or 'hotspots' along the estuaries to inform future social and ecological fieldwork. We found that environmental systems (e.g., wild shellfish populations and the coastal ecosystems in which they are embedded) interact frequently with human systems (e.g., via recreation, aquaculture) along the two estuaries. We identified areas of high shellfish abundance and gathered other information about use patterns that helped us learn where the user groups interact with each other most frequently. We find that this study supports LEK, when integrated into scientific research, as a tool that can help inform community management of marine resources.

832. Transcriptomic Variation Underlying Pollution Resistance in Fish

Submission Category: Natural Sciences

Author(s):
- Anna Briley
- Akila Harishchandra
- Richard T. Di Giulio
- Casey Lindberg

Faculty Mentor: Nishad Jayasandura

Abstract:
Polycyclic aromatic hydrocarbons (PAHs) are highly toxic persistent organic pollutants. A population of Atlantic killifish, Fundulus heteroclitus, in the Elizabeth River, VA have evolved complete resistance to PAH toxicity effects such as developmental cardiac deformities. However, the mechanisms underlying this resistant phenotype and their response to PAH exposure is largely unknown. The goal of this research was to compare differential gene expression patterns

between PAH exposed and unexposed embryos from PAH-sensitive and resistant populations using a RNAseq analysis. We found that a variety of PAH-metabolizing enzymes were upregulated in sensitive fish following exposure, including glutathione-disulfide reductase, glutathione S-transferase, and cytochrome P450. The downregulation of these enzymes in PAH-resistant embryos confirm their recalcitrance to induction of Phase I and II metabolic genes. We also detected a consistent downregulation of genes responsible for the synthesis of mitochondrial ribosomes and electron transport chain proteins in the unexposed resistant phenotype, and this difference seemed to necessitate fewer changes in gene expression upon exposure compared to the sensitive phenotype upon exposure. This suggests that lower levels of mitochondrial activity may contribute to PAH resistance or is a tradeoff of this adaptation. Our next step is to develop bioinformatics pipelines to further explore unknown pathways linked to PAH-resistance and explore two hypotheses, specifically: (i) That the PAH-resistant phenotype will exhibit compensatory gene expression changes in anticipation of maladaptive effects of PAH exposure to maintain homeostasis, (ii) that the unexposed resistant phenotype would show dysregulated gene expression patterns that would be restored following PAH exposure.

833. Social-Ecological Mapping of "Sweet Spots" for Beekeeping and Maple Syrup Producers

Submission Category: Natural Sciences

Author(s): Joseph Romick

Faculty Mentor:
- Jessica Leahy
- Kathleen Bell
- Sara Velardi

Abstract:
Increased interest in sustainable food systems has heightened demand for local agricultural products. This new demand has encouraged local food producers to expand. However, many local food producers are small businesses, whose expansion potentials are uncertain. In this case study of Maine's maple and honey producers, we demonstrate the utility of social-ecological mapping as a tool for assessing the expansion potential of small- and medium-sized maple and honey businesses. The economic benefits derived from maple syrup and honey production are substantial. In 2019, the U.S. produced 4.2 million gallons of syrup worth an estimated $129 million (USDA, 2019) and 154 million pounds of honey worth an estimated $340 million (USDA, 2019). We chose Maine as the study site because it is one of the top producers of maple in the U.S. and has a significant and growing beekeeping community. We identify regions of

opportunities for expansion using spatial and statistical analyses of land cover data, demographic data, and survey responses from small-scale maple and honey producers. We obtained perceptions of opportunities for expansion from the survey data. The results show that the major factors affecting producers are access to biophysical resources and local demand. Combining estimated perceptions of opportunity regions with spatial data on resource base and population centers, we identified expansion hotspots in western and central Maine. The improved ability to identify spatial opportunities in rural maple and honey production communities can be used to offer guidance to rural agriculture stakeholders.

834. The Relationship Between Kidney Function and Cognitive Function in Type 2 Diabetics

Submission Category: Natural Sciences

Author(s): Erika Pacheco

Faculty Mentor: Fayeza Ahmed

Abstract:
Roughly 7%, 23 million, United States citizens are diagnosed with Type 2 Diabetes Mellitus (T2DM). According to the National Institutes of Health, kidney disease is another illness that has a considerable prevalence, about 30 million United States citizens. Individuals who are diagnosed with T2DM have shown decline in proper kidney function, ultimately leading to a form of chronic kidney disease (CKD) in about one- third of T2DM cases. That is often the result of poorly managed diabetes. Even though these are alarming rates of both diseases, these conditions are rarely studied concurrently.
The general focus for this research is to identify whether or not kidney function in individuals with T2DM relates to their cognitive function. Specifically, is albuminuria in individuals with T2DM a risk for poorer cognitive performance? Maine Syracuse Longitudinal Study (MSLS) data for the 121 participants with T2DM is being analyzed through correlational analysis and ANCOVA. This T2DM sample ranges in age from 38 to 93 years (Mean = 64.0), in education from 8 to 20 years (Mean = 13.74), is predominantly White (79%), and comprises 62 females and 59 males. Covariates include age, education, gender, body mass index, cholesterol, and blood pressure. Those variables were chosen because they have a known effect on either cognitive function or diabetes and kidney function. From the MSLS test battery, the main cognitive domains that are included in the study are Working Memory, Verbal Memory, and Scanning and Tracking. Data analysis is in progress.

835. A Facile Thermal Compression Based Technique to Dry Cellulose Nanofiber Film for Renewable and Biodegradable Packaging Application

Submission Category: Natural Sciences

Author(s):
- Md Ikramul Hasan
- Jinwu Wang
- Mehdi Tajvidi

Faculty Mentor: Mehdi Tajvidi

Abstract:
Cellulose nanofibers (CNF) have already been proved to be a potential candidate for next generation renewable and sustainable packaging materials. However, mechanical as well as barrier properties of CNF films are not yet up to the mark for certain applications especially at higher relative humidity. Those properties can be controlled by the degree of fibrillation of fibers and drying methods of the film. Here we prepared CNF films from two types of CNF- standard CNF (90% fines) and high fine CNF (97.4% fines) by casting and filtration and dried those films in four different ways (air drying, oven drying, heat gun drying and hot pressing) to better understand how those parameters affect the mechanical and barrier properties of the films. For standard CNF film, we found the highest tensile strength through hot pressing. However, air dried (casted) films showed the highest tensile strength for high fine CNF films. We also employed thermal compression on those dried films by hot pressing. Our results suggested that a simple hot pressing for 10 minutes at 120 °C and 1.1 MPa after drying of a film increased the tensile strength by 16 MPa (18.0%) and 11 MPa (13.9%) on average for standard CNF film and high fine CNF film, respectively. Also, the hot press compaction can reduce the water vapor permeability by 22.2% and 21.6% for standard CNF film and high fine CNF film, respectively. More remarkably, the oxygen permeability for hot pressed film was almost half of the films that are not hot pressed at 80% relative humidity. This study will provide vital information for the most convenient and economic production of cellulose nanofiber films for barrier packaging applications.

836. Optimization of Pure American Chestnut Seedling Growth in the Greenhouse

Submission Category: Natural Sciences

Author(s): Kat Klebon

Faculty Mentor: Ek Han Tan

Abstract:
The American Chestnut (Castanea dentata) was once an integral part of the forest ecosystem in the Eastern United States, composing one out of every four trees. Currently, Castanea dentata is classified as functionally extinct due to chestnut blight caused by the fungus Cryphonectria parasitica, which has wiped out nearly all mature American Chestnuts. Various methods have been considered in restoring the American Chestnut. Backcross breeding to introduce resistance from the Chinese Chestnut has been implemented, but recent analyses showed that the resistance alleles from Chinese Chestnut are not inherited in the manner initially proposed. Therefore, the transgenic method, in which the OxO gene from wheat is inserted into pure American Chestnuts, has become the most promising method for restoring the species. As OxO American Chestnuts will often be cultivated in a greenhouse prior to their transplantation to breeding orchards, an understanding of the best conditions in which to grow these seedlings is essential. In this experiment, pure American Chestnut seedlings were germinated and grown in two greenhouse settings using four fertilizer and soil treatments: the use of Jolly Gardener soil with and without fertilizer, and the use of tri-mix (one-third peat moss, one-third vermiculate, and one-third perlite) soil with and without fertilizer. Growth metrics (stem diameter, leaf number, height) were measured at intervals for each seedling while Amax and chlorophyll content were measured once on one randomly selected plant of each treatment from each block. This experiment will provide vital information to conservationists of OxO American Chestnut seedlings in the greenhouse production phase.

837. Ilulissat Icefjord Iceberg Behavior in Relation to Tributary Glacier Forcing

Submission Category: Natural Sciences

Author(s): Sydney Baratta

Faculty Mentor: Kristin Schild

Abstract:
Jakobshavn Isbræ, located in West Greenland, is Greenland's largest and fastest outlet glacier, which has experienced irregular periods of net thickening and thinning in its mass. A dominant control on tidewater glacier behavior is the hydrography of the abutting ocean water; therefore, quantifying the structure, velocity, temperature, and salinity is critical to understanding the future stability of Jakobshavn Isbræ. However, due to the thick mélange near the terminus of Jakobshavn Isbræ, standard oceanographic methods for data collection are difficult, as instrument survival is low and access is challenging. In this study, we apply an innovative

approach, deploying iceberg-mounted GPS units and analyzing iceberg movement as a proxy for surface circulation in Ilulissat Fjord. Fjord circulation and its relation to glacier behavior is not well understood at this location, which provides an opportunity for ultimately quantifying speed of ocean water reaching the glacier terminus and its impact on glacier stability. Here we quantify Ilulissat Fjord circulation and show the direct relationship between fjord circulation and glacier behavior. We found that icebergs within the mélange (20-30 km from the glacier terminus) moved only in response to glacier calving events, while those icebergs beyond the mélange were freely flowing and predominantly controlled by fjord circulation. We also found a positive correlation between iceberg residence time and glacier velocity, where in 2014, a reduced residence time within the fjord correlates with an increase in glacier velocity (autumn 2014 and 2019 glacier velocity reached 13,000 m/year and 8,750 m/year, respectively), suggesting an important relationship between glacier stability and fjord circulation. These preliminary results demonstrate the potential for glacier behavior to influence the overturning of fjord waters and necessitate the continued analysis of the Jakobshavn Isbræ-Ilulissat Fjord system.

838. Evaluation of the Microbial and Chemical Variation of the Kombucha Beverage with Repeated Brewing and Prolonged Refrigerated Storage.

Submission Category: Natural Sciences

Author(s):
- Adwoa Dankwa
- L. Brian Perkins
- Jennifer Perry

Faculty Mentor: Jennifer Perry

Abstract:
Introduction:
The health benefits of Kombucha include probiotic, antioxidant, and antimicrobial properties. Production requires self-propagating SCOBYs used in sequential brewing cycles. Changes in microbial composition and metabolites with repeated culture usage and
prolonged storage are unknown. These may result in loss of functional properties or reduced consumer acceptability. There is the need to evaluate the effect of repeated brewing cycles and storage duration on the microbial community and their metabolites. This study evaluates the reproducibility, stability, and functional components of microbial communities and chemical compositions in kombucha over repeated brewing cycles and during refrigerated storage.

Methods:
Twelve SCOBYs were obtained and each brewed following a standard recipe for 10 cycles. Samples were collected at pH 3 and stored at 4 o C for analysis at predetermined time points (weeks 2, 6, 12). Samples were enumerated for total aerobic bacteria, lactic acid bacteria (LAB), acetic acid bacteria (AAB), and yeast on TSA, MRS, ABS, and APDA media respectively. HPLC was used for simultaneous detection of major organic acids, sugars, and alcohol in kombucha. Target analytes were identified by comparing retention times with corresponding analytical standards. Data were subject to ANOVA, MANCOVA, and mapping for visualization.

Results:
Microbial population and chemical profile of kombucha were affected by both repeated brewing cycles and storage. Microbial population levels increased over repeated brewing cycles and declined with storage time. Ethanol concentration and sucrose hydrolysis increased with storage time.

Significance: The composition and functionality of kombucha changes over repeated brewing cycles and storage implying a need for standardization.

839. Glycan Mediated Cellular Differentiation in Cellulose Based Hydrogels

Submission Category: Natural Sciences

Author(s): Ayan Dutta

Faculty Mentor: William Gramlich

Abstract:
Hydrogels mimic the three-dimensional microenvironment of extracellular matrix (ECM) and can be used as a tool for 3D cell culture. The ECM and its components play a crucial role in the proliferation and determination of cell fate. Cell surface glycans are a particular class of biomolecules that are indicative of cell types and considered to have a link towards determining cell fate. However, it is not clearly understood how their presence could affect cell fate. While works have been done using 2D models to understand the role of glycans in cellular behavior, it has been found that cells behave differently in a 3D environment. Synthetic 3D matrices are a better choice for studying the cellular behavior towards extracellular stimuli comparing to those of 2D models because their properties can be tunable as desired. Previous studies in our lab have shown a significantly high survival rate for human mesenchymal stem cells (hMSCs) when encapsulated in norbornene functionalized carboxymethyl cellulose (CMC) based hydrogels. My research will be focused on incorporating different types of glycans within 3D hydrogel matrices

and systematically study how they interact with cells in a 3D system. The ultimate goal is to be able to control cell fate in a three-dimensional system by using external stimuli.

840. Preliminary Quality Assessment of Green Crab (Carcinus Maenas) Roe

Submission Category: Natural Sciences

Author(s):
- Holly Leung
- Jennifer Perry
- Denise Skonberg

Faculty Mentor: Denise Skonberg

Abstract:
The purpose of this study was to determine the proximate composition, color, and coliform counts of roe from green crabs harvested in New England. As a first step to valorizing green crab roe, baseline information is needed to assess its quality and marketability. Carcinus maenas were trapped live and collected from Boothbay, Maine, and female crabs were sorted for roe extraction. Roe was extracted from 15 pounds of female crabs and combined to form a homogenous sampling pool. Proximate compositions were obtained using the following methods: moisture content (n=5) via oven drying, ash (n=2) via muffle oven (550℃), crude protein based on total nitrogen content (n=3) as determined by combustion analysis, and lipids (n=3) by ether extraction. Instrumental color (L*a*b*) via spectrophotometry and coliform counts were determined on days one and seven of refrigerated storage. Average values (+/- s.d) for moisture, ash, lipids, and crude protein were 60.5+0.2%, 1.7+0.1%, 9.2+0.1%, and 25.7+0.1%, respectively. The roe appeared as tiny, oozy, bright-orange colored eggs and had average instrumental color values of L* 52.1+0.3, a* 29.9+0.3, and b* 69.3+0.1. There were no coliforms detected in the roe on day one, but on day seven 1.12 cfu/mL was identified. Compared to Chinese mitten crab roe composition, moisture and crude protein were significantly lower ($p<0.05$). This study unveils a new avenue of potential use in food of invasive green crab roe.

841. Using Poultry as a Method of Control for Ruminant Pathogen *Parelaphostrongylus tenuis*

Submission Category: Natural Sciences

Author(s): Tuuli Overturf

Faculty Mentor: Anne Lichtenwalner

Abstract:
Parelaphostrongylus tenuis, referred to as "brainworm," is a parasite that originates in white-tailed deer (*Odocoileus virginianus*, WTD) and has the ability to spread and cause harm to livestock, particularly small ruminants. Larvae are shed in the feces of WTD and are picked up by gastropods (e.g.snails), where they mature to their infective stage. When livestock accidentally ingest the snails, the worms migrate through their spinal cord and around the brain, causing damage that can be fatal. Preventing brainworm infection is important to livestock owners, and a proposed method of mitigating risk is gastropod control. Snail populations can be controlled by introducing poultry (e.g. ducks); however, it is unknown whether the poultry are at risk or if they might even contribute to larvae dispersal.

The goals of this project are to determine a) whether poultry are an effective control for snails, b) whether poultry are at risk of harm when ingesting brainworm-infected gastropods, and c) whether *P. tenuis* larvae can survive the avian digestive tract to potentially go on to infect livestock. Ducks and/or chickens would be fed infected snails in several trials that monitor how many they eat, whether they exhibit any neurological signs, odd behaviors, or illness, and whether any parasites are present in the feces. The birds are not expected to be infected or have larvae present in the feces. Evaluating poultry as a potential method for brainworm control could help inform livestock management decisions, potentially leading to lower risk of *P. tenuis* infection.

842. Impact of Newborn Skin to Skin on Bonding, Breastfeeding and Thermoregulation

Submission Category: Natural Sciences

Author(s):
- Summer Egbert
- Catherine Christiansen
- Meghan Mcdonald
- Emily Lund

Faculty Mentor: Valerie Herbert

Abstract:
Describing the Focus
Skin to skin (STS) contact has evolved into a highly utilized practice that is defined as placing an infant's bare chest on the mother's bare chest. STS contact provides numerous beneficial outcomes for full terms infants. When infants are unable to maintain thermoregulation, there is an increased risk of infant mortality and morbidity. The lack of immediate maternal-newborn bonding negatively impacts adaptation to extrauterine life and breastfeeding initiation. The

purpose of this research is to evaluate the benefits of implementing STS contact in full term infants immediately after birth.

Methods

Using the CINAHL database through the University of Maine Fogler Library website, we searched for evidence-based articles related to the benefits of STS care in full term newborn infants. We researched benefits that would be applicable to the newborn from time of birth to discharge from the hospital. Phrases used in our search were: STS contact, breastfeeding, newborn temperature and newborn bonding. Our initial search resulted in ten evidence-based and peer-reviewed articles that were published within the last five years. We synthesized these ten articles for our research while specifically focusing on three articles.

Outcomes

Through the research conducted, immediate STS care of newborns may increase neonatal temperature regulation, mother-baby bonding, and breastfeeding success. This intervention should be implemented in all immediate postpartum care to increase the health outcomes of infants. Further research is needed to determine the effectiveness of STS care in these health outcomes.

843. Optimization of Carcinus maenas Fermentation

Submission Category: Natural Sciences

Author(s):

- Delaney Greiner
- Denise Skonberg
- Brian Perkins
- Jennifer Perry

Faculty Mentor: Jennifer Perry

Abstract:

Carcinus maenas is an invasive species inhabiting the Atlantic and Pacific coasts of North America. Marketable uses for this species may help establish a fishery to reduce ecosystem damage and provide economic benefits to Maine fishers. Previous research supports the viable use of Carcinus maenas for production of a spontaneously fermented condiment. This study investigated the effect of fermentation temperature and starter cultures on amine nitrogen and histamine content in resulting green crab sauce. Green crabs trapped off the Maine coast were euthanized by freezing, crushed in a Hobart grinder, combined with 20% (w/w) salt in triplicate and fermented at 24°C, 30°C (with and without Tetragenococcus halophilus), 37°C (with and without Staphylococcus carnosus), and 50°C. Sampling occurred after fermenting 15, 30, 60, and

90 days. Amine nitrogen was quantified by formol titration. Histamine content was determined by HPLC using Waters AccQ·Tag. Data were analyzed by Shapiro test for normality, ANOVA or Kruskal Wallis test for variance, and Tukey's HSD post hoc test in R. No significant differences ($p>0.05$) in histamine content (average 6.7 ± 0.9 mg/100mL) were observed. Amine nitrogen at 30, 37, and 50°C was significantly higher than at 24°C, indicating greater proteolysis in these treatments. The treatments reached a maximum amine nitrogen of 423.9, 682.9, 679.8, and 515.7 mgN/100mL at 24°C, 30°C, 37°C, and 50°C respectively, on day 90. The data shows that S. carnosus and T. halophilus are ineffective in reducing histamine and temperatures ranging from 30-37°C appear ideal for production of a fermented crab condiment.

844. Fungal Communities of Ancient and Contemporary Antarctic Sponges

Submission Category: Natural Sciences

Author(s): Nicole Ritchey

Faculty Mentor: Laurie Connell

Abstract:
Not much is known about community composition of fungi in marine sponges, particularly those in Antarctica. During an expedition to Ross Island and the McMurdo Ice Shelf, six ancient sponges were collected from the surface of the ice shelf and one contemporary sponge from Dayton's Wall, McMurdo Sound. The ancient sponges were in a debris field that had become entrained in the ice from the sea floor over the last tens to hundreds of years. The contemporary sponge, Anoxycalyx joubini, was collected in-situ for community comparison. Sequence from the Internal Transcribed Spacer (ITS) region was used to identify fungi from the sponge samples. Over 200 species were identified, across ten phyla (including Neocallimastigomycota) and one subphylum (Kickxellomycotina). Three main community structures were found, each one dominated by either the Ascomycota, Basidiomycota, or Chytridiomycota. Fungal species diversity was fairly diverse in the majority of the samples, indicating balance of richness and abundance. Sponges dominated by the Chytridiomycota had the most fungal species diversity. This study was able to find potential for species evolution by identifying base changes in multiple sequences of two species, Glaciozyma antarctica & Leucosporidium sp.. Because of this long term isolation, it is likely that species have developed subspecies or diverged into new species in the ancient sponge samples. These samples hold a wealth of fungal information, and next steps to culture and fully identify novel species should be taken. This research will add to our understanding of fungal communities in marine sponges across the globe.

845. Interventions to Decrease Chronic Obstructive Pulmonary Disorder Exacerbations

Submission Category: Natural Sciences

Author(s):
- Alyssa Karlins
- Kristen Veilleux
- Nicole Despres
- Sophie Russell

Faculty Mentor: Valerie Herbert

Abstract:
PICO Question:
Patients over 50 with Chronic Obstructive Pulmonary Disease (COPD) that use non-pharmacological interventions such as high-frequency chest wall oscillation (HFCWO), intrapulmonary percussive ventilation (IPV), and aerobic exercise 3 times/week over 1 year have fewer acute exacerbations/readmissions compared to patients that only use prescribed medications.

Topic and Purpose:
COPD is a progressive lung disease that leads to decreased quality of life. Patients solely using pharmacological therapy suffer from frequent exacerbations. The introduction of additional interventions, HFCWO, IPV, and exercise, may help patients maintain higher quality of life. The purpose of this composition is to review if these interventions decrease the annual number of exacerbations and increase quality of life for patients with COPD.

Methods/Results:
Using the CINAHL database on the University of Maine Fogler library, we searched for articles relevant to non-pharmacological therapies in relation to COPD to ascertain if there was a significant effect. To narrow the search, we chose articles that focused on patients over the age of 50. We used phrases including: COPD, HFCWO, IPV, exercise, and exacerbations. Evidence based, peer reviewed articles less than ten years old were used. After reviewing 20 articles, we focused on eleven that were pertinent. Significant information will be collected from each article and compared.

Outcomes: Upon review of literature, non-pharmacological interventions (HFCWO, IPV, and exercise), can reduce the amount of exacerbations and hospital admissions in COPD patients than those that do not use these techniques and devices. In addition, these interventions increase overall quality of life.

846. Assessing Long Range Aerosol Transport in the North Pacific on Seasonal to Millennial Time Scales

Submission Category: Natural Sciences

Author(s): Hanna Brooks

Faculty Mentor: Karl Kreutz

Abstract:
Recent changes in Arctic climate are due in part to atmosphere/ocean/ice processes including cloud formation, sea ice, microorganisms, and solar radiation that affect atmospheric aerosol characteristics. The extreme patterns of Arctic seasonality also play a role: a yearly cycle of dominantly polar night during the winter shifts to dominantly polar day during the summer. The relevance of these aerosol processes varies between the day and night, enhancing the climate seasonality of the region. Anthropogenic long-range transported aerosols are particles emitted into the atmosphere through human activities. Examination of the long term trends through time shows the effects of policy, culture, technology, and natural variability.
I will present trace element concentration data from Mt. Hunter, Alaska. The two 208 meter long cores, collected from Mt. Hunter, are archives of aerosols extending from 2013 to 10,000 years before present. A longer-term perspective on natural climate change in the North Pacific region and the interplay of natural and anthropogenic factors in current climate trends can be developed by examining the trends in anthropogenic aerosols preserved in these ice cores. In this study, I examine the effects of seasonality in anthropogenic aerosols using trace element concentration data collected by inductively coupled plasma mass spectroscopy, including lead, copper, and cesium. Additionally, I evaluate time-resolved impacts of governmental policy (e.g., phase out of leaded gasoline), cultural shifts (e.g., industrial revolutions) and technological improvements of mining and manufacturing using trace element concentration data.

847. Public Perception of Gray Seals in New England: A Media Content Analysis

Submission Category: Natural Sciences

Author(s):

- Shannon Smith
- Gabrianne McIntosh
- Christina McCosker

Faculty Mentor: Kristina Cammen

Abstract:
The population of gray seals in New England has experienced drastic change in abundance in recent years. They are known to have been historically present along the coast of New England, but from the late 19th to the early 20th century, bounty programs in Maine and Massachusetts caused populations to drastically decrease. Since 1972, gray seals have been protected under the Marine Mammal Protection Act (MMPA), and their populations have grown quickly over the past several decades. Although this population recovery should be celebrated, the public response has been mixed. This study investigates the hypothesis that changing population numbers caused a change in the general attitude toward grey seals and addresses how the topics surrounding seals have changed over time. We analyzed changes in the public perception of gray seals through an analysis of 88 newspaper articles published between 1980 and 2019 in the Boston Globe. Articles for analysis were identified by searching the archives for the key word “gray seal”. The articles were then analyzed in R Studio to identify and count certain keywords such as "shark" and "fish" and track the prevalence of these keywords over time. Our results showed a shift in focus of articles from seal sightings and tourism in early years toward concern over the return of sharks and negative impacts on fisheries. The information from this analysis can be used to better understand how to deal with increased human-wildlife interactions and can help inform the management of protected species that are recovering.

848. Physiological Comparison of Highbush and Lowbush Blueberries and Their Response to Chemical Application and Drought Stress

Submission Category: Natural Sciences

Author(s): Emma Gibbons

Faculty Mentor: Yongjiang Zhang

Abstract:
Blueberries are known to be a hardy, drought resistance plant. In understanding the functional factors of drought resistance, more efficient measures could be made by growers to prevent water loss and crop yield reduction to solidify the production of these widely used crops. Highbush and lowbush blueberries will be compared through their physiological properties such as stomatal conductance, water potential, turgor loss, leaf area, chlorophyll content, and anthocyanin content, observed in two different study regions. In addition, the experimental application of cytokinin, a well-known natural plant hormone that has potential roles in plant stress management will be performed on lowbush blueberry plants. This research aims to develop an understanding of plant drought response and the role of cytokinin hormone, which will potentially improve a farmers’

ability to develop more efficient irrigation and production methods to minimize crop degradation and loss of yield. Several factors inhibited the full potential of this experiment – COVID-19 related restrictions caused a series of limitations such as improper timing of installation and chemical application, causing a high amount of stress to the blueberry plants. This prevented us from carrying out the experiment in the exact way it was proposed as well as obtaining the data that we hypothesized. Many of the plants experienced amounts of stress that were too detrimental, causing a loss of function and eventual plant mortality. Both highbush and lowbush plants experienced drought symptoms - browning leaves, leaf drop, tip dieback - coupled with progressively drier soil moisture content. However, Between the highbush and lowbush blueberries, the physiological measurements were relatively similar in proportion to one another after and during the drought. However, the highbush plants maintained a higher photosynthetic rate, anthocyanin content, and did not lose functionality as drastically as the lowbush.

849. Effects of Biochar-Compost Mix on Wild Blueberry Soil Properties for Mitigating Crop Drought Stress

Submission Category: Natural Sciences

Author(s):
- Zachary Maynor
- Rafa Tasnim

Faculty Mentor: Yongjiang Zhang

Abstract:
Warming and increasing drought due to global climate change have increased water deficits and negatively affected the wild blueberry crop, one of the most important commercial crops in Maine. To mitigate those negative effects, this study tested water-holding capacity, soil pH, and nutrients of wild blueberry soil mixed with different rates of “biochar-compost mix”, which is a sustainable environment-friendly soil amendment. The biochar was provided by a biofuel company in Maine as a waste by-product produced from wood residuals and the compost was provided by the University of Maine composting facility. Six replicates of wild blueberry field soil were mixed with biochar-compost mix (50% biochar + 50% compost and 70% biochar + 30% compost) at 0%, 5%, 10% and 20% w/w ratios to test the water holding capacity of soil by water-percolation method. Those samples were also tested for their pH and nutrient elements. Here, 70% biochar + 30% compost mix showed the highest water holding capacity while mixed with the soil at 20% w/w rate. Also, the necessary major (P, K, Ca, Mg, S) and minor (B, Cu, Mn) nutrient elements were within the optimum range, in that ratio of biochar-compost mixed samples, which are required for wild blueberries. Therefore, from this study, it can be

recommended to use 70% biochar + 30% compost mix as a soil amendment with the wild blueberry soil to increase its water holding capacity. However, this addition of soil amendment also increased the pH of soil up to 7, which might not be beneficial for wild blueberry crops since they thrive better in acidic soil (pH of 4-5). Hence, in this case, it is recommended to also apply sulfur to the soil to reduce the soil pH.

850. The Ecology of the Blacklegged Tick in an Emergent Area for Tickborne Disease

Submission Category: Natural Sciences

Author(s): Griffin Dill

Faculty Mentor: Allison Gardner

Abstract:
The blacklegged tick (Ixodes scapularis) is the primary vector of Borrelia burgdorferi, the causative agent of Lyme disease, and other tick-borne pathogens that pose threats to human health. As the blacklegged tick expands its geographic range and population in North America, factors including host abundance and human-induced land-use changes can play a contributing role in this expansion. Small mammal hosts serve as important reservoirs of tick-borne pathogens, with the white-footed mouse (Peromyscus leucopus) often considered the principle reservoir. A sympatric species, the deer mouse (Peromyscus maniculatus), can also serve as a reservoir of tick-borne pathogens, however its role in the maintenance of these pathogens has not been widely characterized. We assessed differences in tick infestation and tick-borne pathogen prevalence between the two Peromyscus species, while also analyzing the density and pathogen prevalence among host-seeking ticks. We conducted small mammal and tick collections across three broad land-use classifications and habitat types within the Penobscot River Valley in Maine, an emergent area for tick-borne disease. While P. leucopus exhibited a higher average tick burden (M=1.49; SD=2.83) than P. maniculatus (M=0.88; SD=1.65), infection prevalence of B. burgdorferi was higher in P. maniculatus (62% vs 45%). Land-use and habitat also impacted tick infestation rates, with tick burdens highest in residential settings, compared to recreational and agricultural/industrial settings, and in edge habitat compared to forest and open habitat. These differences among host species and across land-use gradients highlight the importance of secondary reservoirs in the maintenance of tick-borne disease.

851. Assessing the Utility of Dynamic Particle Imaging in South Pole Ice Core Dust Analysis

Submission Category: Natural Sciences

Author(s):
- Aaron Chesler
- Bess Koffman
- Karl Kreutz
- Dominic Winski
- David Ferris
- Zayta Thundercloud
- Joseph Mahon
- Jihong-Cole Dai
- Mark Wells
- Michael Handley
- Aaron Putnam
- Katherine Anderson
- Natalie Harmon

Faculty Mentor: Karl Kreutz

Abstract:
Microparticle concentration and size distributions can be measured using coulter counter techniques on discrete samples, which provides accurate volume measurements, and/or high-resolution laser based (Abakus) particle counters paired with continuous flow analysis (CFA), which provides high resolution and continuous data. Recent evidence suggests that the spherical particle shape assumption may be incorrect due to variations in particle shape (i.e., aspect ratio). Dynamic particle imaging methodologies (DPI; i.e., FlowCAM) have been used by the biological community recently to measure physical properties of micro-sized phytoplankton (i.e., length, width, aspect ratio). We use the dynamic particle imaging technique to measure microparticles over the past 54,000 years and compare to Abakus and Coulter Counter measurements collected from the SPICEcore during CFA melting. Discrete samples (spanning 35-135years) were collected during CFA melting and measured via Coulter Counter and dynamic particle imaging techniques during three time periods; Termination I (n = 19, 10-18,000 years ago), LGM (n = 20, 18-26,000 years ago), and Heinrich Stadials 4 and 5 (n = 16, 36-50,000 years ago). Using DPI width measurements we calculate particle spherical and ellipsoidal volume measurements using the assumption that particle width is equal to particle height and examine coarse (5.14-6.4μm) size dependent aspect ratios. Termination I coarse size dependent aspect ratio distributions are statistically different to LGM and Henrich Stadials 4 and 5 (p-value

< 0.05). Temporally, spherical volume estimates compared to ellipsoidal volume estimates are less offset during Termination 1 but more offset during the LGM, indicating particle shape is temporally variable.

852. Uptake and Redistribution of Bacillus cereus Spores in Kombucha Systems

Submission Category: Natural Sciences

Author(s):
- Alexandria Bromley
- Jennifer Perry

Faculty Mentor: Jennifer Perry

Abstract:
Kombucha is known for its high microbial load and highly acidic nature that inhibits most extraneous microorganisms from surviving in the beverage. However, bacterial spore contamination and survival in the culture has been documented. It is unknown whether spores can survive in this beverage, or whether they are transmitted to daughter SCOBYs. In this study Bacillus cereus spores were inoculated onto SCOBY, in unfermented tea or in fermented kombucha and survival and redistribution (to daughter SCOBY, finished or stored fermentate) were assessed by cultural selective enrichment. The data collected from the presence or absence of B. cereus in each sample was analyzed using best fit logistic models (glm function) in R studio to determine any significant differences ($p < 0.05$) for each inoculation treatment. Integration of spores was observed in the mother SCOBY after direct SCOBY inoculation, and B. cereus was inconsistently transferred to the daughter SCOBY or liquid. On the other hand, only one replicate showed survival of spores into the liquid after direct liquid inoculation, and B. cereus was not detected after secondary fermentation or storage. While results did not indicate any specific pattern, they suggest that contamination from bacterial spores may occur at any stage of fermentation. Additional investigation should explore whether this risk is mitigated by subsequent product storage.

853. Determining How Prophage Interaction Impacts the Expression of the Transcription Factor, whiB7

Submission Category: Natural Sciences

Author(s):

- Sarah McCallister
- Jaycee Cushman
- Sally Dixon
- Keith Hutchison

Faculty Mentor: Sally Dixon

Abstract:
Individuals die worldwide from mycobacterial infections than any other infectious agent. The overuse and misuse of antibiotics is an urgent threat as life threatening bacteria, Mycobacterium tuberculosis and Mycobacterium abscessus, are often extensively resistant to antibiotics and challenging to treat. Clarithromycin and amikacin are treatments for M. abscessus infections but resistant to both drugs due to high expression of whiB7, a transcription factor that activates expression in conserved mycobacterium resistant genes2. Prophages are known to increase antibiotic resistance in some bacteria but M. abscessus prophages, while the role in drug resistance is not fully characterized3. The Molloy lab demonstrated that the presence of two co-existing prophages, McProf and BPs, interact and alter expression of whiB7 and drug resistance M. chelonae. It is not understood how these two prophages interact to alter whiB7 expression. Cultures of lysogens, cells carrying prophages, have a small fraction of cells that undergo induction switches to lytic expression. McProf only carries out lysogenic infection while BPs spontaneously undergoes induction. We don't know if BPs lytic or lysogenic expression is important for regulating whiB7 expression. To determine if BPs induction and lytic infection increases whiB7 expression with McProf present, an mCherry-whiB7 M. chelonae reporter strain carrying McProf and GFP-BPs fluorophage will be constructed. If BPs lytic infection plays a role in whiB7 expression, we'll be able to detect BPs lytic expression and whiB7 expression in single cells. This allows us to measure the fraction of cells in the double lysogen that will undergo induction events and if it coincides with increased whiB7 expression.

854. Essential Factors for Mycelium-lignocellulosic Biocomposites Production

Submission Category: Natural Sciences

Author(s): Wenjing Sun

Faculty Mentor: Mehdi Tajvidi

Abstract:
Mycelium-lignocellulosic biocomposites are novel materials that provide the opportunity to achieve a biobased circular economy. By inoculating filamentous white-rot fungi in particles of lignocellulosic biomass for days and post-processing afterward, different forms of biocomposites could be produced. This study investigated physical and mechanical properties of two forms of biocomposites: as-grown foams and compressed panels. The functionality of mycelium in the composite system and the essential factors affecting specific applications will also be discussed.

855. The Suitability of Macroalgal Species for Integrated Multi-Trophic Aquaculture in Land-Based and Ocean-Based Aquaculture Farms: A Literature Review

Submission Category: Natural Sciences

Author(s): Hannah Koehler

Faculty Mentor: Susan Brawley

Abstract:
Maine's aquaculture industry is expanding with three major finfish recirculating aquaculture systems (RAS) recently approved for operation. Under some conditions, aquaculture effluent may cause eutrophication in receiving waters and one potential solution is integrated multi-trophic aquaculture (IMTA). The purpose of this review is to evaluate marine algal species that may have suitability to provide extractive capacity for IMTA in Maine's finfish farms. Candidates being considered are *Alaria esculenta*, *Chondrus crispus*, *Gracilaria tikvahiae*, *Palmaria palmata*, *Porphyra umbilicalis*, *Saccharina angustissima*, *Saccharina latissima*, *Ulva lactuca*, and *Wildemania amplissima*. This literature review was performed to determine the environmental parameters that promote high macroalgal growth and to determine the tissue nitrogen concentrations for each macroalgal candidate. A review of the aquaculture permits provided information regarding the nutrient concentrations and water parameters of wastewater from RAS. The data acquired from this two-part review allowed consideration of 1) whether wastewater produced from these facilities provides suitable conditions for algal growth, and 2) the potential magnitude of nutrient removal by different algae. The pre-discharge wastewater would provide nutrient-enriched conditions similar to those of algal culture media; however, macroalgal space requirements may reduce the extent of nutrient removal before the wastewater is discharged. Water temperature in aquaculture facilities limits the species that could be co-cultivated, making cold water kelps unsuitable for RAS IMTA. Several red algal species appear to be the most promising for consideration for RAS and open ocean IMTA. We encourage Maine's companies and/or State government to consider designs for IMTA facilities, and to support pilot trials.

856. Turn the Tap: Integrated Research to Support Sustainable Irrigation Practices on Northeast Vegetable Farms

Submission Category: Natural Sciences

Author(s): Haley Jean

Faculty Mentor: Rachel Schattman

Abstract:
The northeastern United States has a growing number of small, highly diversified farms; this group has grown by 84% since 1992. Many of these small-scale operations use irrigation systems but have imprecise methods to establish irrigation needs. Prior research has established that farmers in this region assess the need for irrigation by crop conditions (showing signs of wilt) or feel of soil. When soils are dry or crops are already showing signs of low moisture, it is likely that crop quality and/or yield has already been undermined. Farmers often do not know how much water their crop needs and how much water is needed through irrigation. Additionally, the over-application of water can lead to nutrient leaching.
There are opportunities to enhance water efficiency practices in the Northeast. Efficient water use can help farmers conserve water, as well as maximize crop yield and quality. Many other regions of the United States have started using soil moisture sensing technology to increase the efficiency of their irrigation systems. With a lack of understanding of the best practices of irrigation systems in the northeast, this project wishes to address the knowledge gap expressed by farmers concerning soil moisture monitoring and irrigation systems.
My research project is part of a larger effort called “Turn the Tap: Integrated research to support sustainable irrigation on northeast vegetable farms.” Within this greater project, I ask the following questions: (1) Does monitoring soil moisture improve crop yield and quality? (2) Does monitoring soil moisture reduce water applied per-unit harvested? (3) Is nutrient leaching reduced when moisture monitoring systems are in place, compared to traditional irrigation management?

857. Forward Genomics of a Complex Trait: Mammalian Basal Metabolic Rate

Submission Category: Natural Sciences

Author(s):

- Caleigh Charlebois
- Diane Genereux
- Joy-El Barbour Talbot

- Ana Breit

Faculty Mentor: Danielle Levesque

Abstract:
We now understand mammalian basal metabolic rate, or BMR, as an incredibly complex trait. Even among closely related species, the trait displays much diversity. In some mammals, BMR may vary greatly within a single day, and these cycles differ during different stages in animals' development. The mechanisms through which regulation of metabolic rate is achieved are also varied, including cellular processes, behaviors, and anatomical features such as vasculature and insulation. As genes control all of these factors, the genetics of BMR is equally complex. One tool for uncovering genetic correlates of a complex phenotype is the forward genomics pipeline developed by the Hiller group at the Max Planck Institute in Dresden, which allowed researchers to correctly identify the inactivated gene associated with loss of a phenotype by inputting only the full genomes of a set of mammals and indicating which species in the set had lost the phenotype. This pipeline has only been applied to binary traits which are either present or absent, not continuous traits such as basal metabolic rate and body temperature which are represented by numerical measurements. This project documents the outcome of using different thresholds to convert a continuous trait (mammalian BMR) to a binary trait to be analyzed by the Hiller pipeline. It also explores the assumptions made by both the Hiller forward genomics analysis and another pipeline produced by the Bejerano lab at Stanford University to determine whether it is possible to modify those approaches to incorporate analysis of continuous traits.

858. Impact of Salting and Brining on Physicochemical and Microbial Quality of Sugar Kelp

Submission Category: Natural Sciences

Author(s):
- Richa Arya
- Jennifer Perry

Faculty Mentor: Jennifer Perry

Abstract:
Sugar kelp (Saccharina latissima) is a marine alga that is consumed for its nutritional benefits. Food preservation techniques such as drying are used to extend kelp shelf life. Salting and brining have been used on other algae, but their effects on sugar kelp have not been

characterized. In this study, the effect of salting and brining treatments on the physicochemical and microbial properties of sugar kelp were analyzed throughout storage for up to 90 days. Fresh sugar kelp was stored at -20°C after vacuum packaging. Frozen samples were thawed at 4°C for 24 h before experiments. Dry salting (30% w/w) and brining (40% NaCl solution) treatments were applied to sugar kelp until water activity reached ≤ 0.77. Salted kelp was stored at ambient temperature or 4°C for up to 90 days. Physicochemical properties (water activity, moisture, color), and microbial quality (aerobic mesophilic, psychrotrophic, marine bacteria) were assessed on days 0, 30, 60 and 90. One-way ANOVA ($p<0.05$) was used to assess the effects of treatment, storage temperature and time on physicochemical and microbial characteristics of sugar kelp.
Salting and brining significantly reduced the water activity and moisture content of sugar kelp. During storage, the darkness of treated sugar kelp samples significantly increased, regardless of storage temperature. No microbial counts exceeded 2.0 log CFU/g after 30 days for brined and salted kelp stored at ambient temperature and 4°C. The results indicated that salting and brining can be used as an alternative food preservation technology for high quality sugar kelp.

859. Multifunctional Cellulose Nanocrystal Films prepared with Trivalent Metal Ions for Food Packaging

Submission Category: Natural Sciences

Author(s): Cong Chen

Faculty Mentor: Douglas Gardner

Abstract:
Conventional fossil-based plastic products cause serious environmental pollution and have detrimental impacts on wildlife, thus finding suitable eco-friendly materials is becoming an urgent need for our planet. Cellulose nanocrystals (CNCs), as a sustainable and biodegradable material, shows great potential for the next generation food packaging. Neat CNC films exhibit extraordinary mechanical and oxygen barrier properties and are transparent. However, their water sensitivity and flammability limit wide commercial applications. The aim of this work is to produce high quality CNC films with multifunctional properties using a facile processing method. Aqueous CNC suspensions were ion exchanged with different concentrations of trivalent metal ions (Al3+, Fe3+) that undergo cross-linking between the metal ions and sulfate half-ester groups of the CNCs. Homogeneous, transparent and flexible ion exchanged CNC films were formed by suspension casting. The ion exchanged CNC films exhibit excellent UV absorption, oxygen barrier property at high relative humidity, and flame self-extinction. In addition, the water vapor transmission rate of the CNC cross-linked films was decreased, and the

water absorption durability was improved. We believe that this facile and environmentally friendly approach to produce CNC films with multifunctional properties will present great potential in packaging applications.

860. Phenolic Extracts from Wild Blueberries Promote Vascularization Associated with Wound Healing

Submission Category: Natural Sciences

Author(s):
- Natalie VandenAkker
- Tolu Adekeye
- James Weber
- Dorothy Klimis-Zacas

Faculty Mentor: Dorothy Klimis-Zacas

Abstract:
Wounds occur in over 15 million people with approximately $60 billion spent annually on wound care. Deficient neovascularization is one of the major factors that promotes chronic wounds such as diabetic foot ulcers which ultimately results in amputation. Currently, there is no adequate treatment for effective wound healing. Previously, we reported that extracts from wild blueberries promote angiogenesis in HUVEC cells by increasing cell migration, angiogenesis, and upregulating the expression of VEGF, but the in vivo effect is unknown. To investigate this, phenolic (PE) and anthocyanin (ACN) fractions were extracted from wild blueberries and their composition was determined by HPLC. Fifty-six Sprague-Dawley rats were grouped into eight animals per group in seven groups consisting of Control, PE 250mg/dl, 500mg/dl, 1000mg/dl, PE+ACN 250mg/dl, 500mg/dl and 1000mg/dl. Wounds were created on the dorsal side of each rat and treated with the above extracts, once per day for 7days. To assess the effect of PE and PE+ ACN on wound closure, the wound closure area was photographed daily, and percent of wound closure was determined using ImageJ. To assess vascularization, the wound tissues were excised, stained with H&E, visualized and quantified under light microscope. We observed increased wound closure (20%) and upregulated vascularization in the PE treated group (500mg/dl) compared to control. Further analyses will investigate vascular gene expression using qPCR. This research may be beneficial to patients with acute and chronic wounds and will positively promote economic growth for wild blueberry growers and the state of Maine.

861. Assessing Spatial and Temporal Variability in Zooplankton Biomass in the Gulf of Maine

Submission Category: Natural Sciences

Author(s):
- Emma Dullaert
- Jeffrey Runge

Faculty Mentor: Lee Karp-Boss

Abstract:
The Gulf of Maine (GoM) harbors a productive ecosystem that supports a wide variety of marine life, providing services upon which local communities rely. In light of the rapid warming the GoM has been experiencing in recent decades, a pressing need exists to quantify how its marine ecosystem is affected by climate-driven change. Zooplankton represent an important link in energy transfer from lower to higher trophic levels in the marine environment as they control the abundance and composition of phytoplankton and are a food source for consumer from pelagic forage fish to baleen whales. The present study investigates how zooplankton biomass in the GoM has changed over space and time in recent years by analyzing zooplankton dry weight data collected from the deep Wilkinson Basin, the Damariscotta Estuary, and the Maine Coastal Current. The primary objectives are to determine whether there have been changes in seasonal biomass trends and the relative contribution to the overall biomass of the planktonic copepod, Calanus finmarchicus, a sentinel species. The results provide insight into changes in the structure and function of the Gulf of Maine ecosystem as a whole.

862. Influence of Energy Mix and Location in Whole Building Life Cycle Assessment

Submission Category: Natural Sciences

Author(s): Marilia Hellmeister

Faculty Mentor: Stephen M. Shaler

Abstract:
The building sector is responsible for more than forty percent of carbon emissions and greenhouse gases associated with embodied carbon. A third of the global energy consumption is destined to supply buildings and meet user comfort requirements. The type of energy source that provides energy to a determined location is dependent on policies, environment, and location.

Therefore different regions present different attributes, different energy mixes, and different suppliers and demand of building materials. The proposed analysis will utilize a Life Cycle Assessment software (LCA) and its database to estimate environmental impacts generated by the construction of a building through its whole life cycle period. The influence of location on the sourcing, transportation, distribution, use, and final disposal will be analyzed in terms of global warming potential and other harmful environmental impacts.

863. Brewers' Spent Grain (BSG) Fermentation.

Submission Category: Natural Sciences

Author(s): Adoum Fadaya Arabi

Faculty Mentor: Denise Skonberg

Abstract:
This study focuses on the upcycling of Brewers' Spent Grain or BSG. BSG is a major by-product from the brewing industry. It is generated in large quantities that are expected to increase each year due to increasing beer production in the U.S. BSG is currently used animal feed. However, BSG can be used as a human food ingredient due to its protein and fiber contents. Previous research was limited to the incorporation of BSG flour into cereal products such as breads, cookies, muffins, and pastas with adverse effects on the sensory qualities at 20% or higher levels of BSG flour incorporation. Additional challenges of BSG are the high moisture content that accelerates its spoilage, lower sensory acceptability, and mediocre protein quality.
To overcome these limitations, we suggest an approach which consists of transforming the BSG into a new product through fermentation.
The objectives of this study are to monitor the effects of fungal fermentation using *Rhizopus oligosporus* on the nutritional (soluble proteins), sensorial, and functional properties of BSG. The effects of temperature, PH, and fermentation time on the soluble protein content of the final by-product will also be assessed. The resulting product with higher soluble protein content and improved functional properties will be a potential new food ingredient for the food industry. Upcycling of BSG via fungal fermentation will also bring additional economic benefits for breweries, help prevent food waste, and contribute to overall environmental protection.

864. Differences in Management Action Acceptability for Deer in Maine

Submission Category: Natural Sciences

Author(s): Anna Fitch

Faculty Mentor: Carly Sponarski

Abstract:
People feeding deer in the winter can cause increased human-deer conflict. The Maine Department of Inland Fisheries and Wildlife (MDIFW) was interested in exploring Maine's residents' tolerance of various scenarios of human-deer conflicts that are experienced by state residents. We explored differences and similarities in the acceptability and the amount of consensus between males and females over 4 scenarios involving white-tailed deer (Odocoileus virginianus) management in Maine. Data were collected using questionnaires that were distributed to Maine residents. A total of 2,000 questionnaires were mailed to randomly selected residents in Maine with a response rate was 19% (339/1,834). The Potential for Conflict Index 2 (PCI2) was used to assess the level of consensus and an independent t-test was used to assess similarities and differences across different management opinions for each of the 4 scenarios. The 4 scenarios examined were: 1) deer are eating a person's garden; 2) an increasing frequency of deer-vehicle collisions in a person's neighborhood; 3) an increasing rate of Lyme disease in a person's region; and 4) Chronic Wasting Disease is found in a person's region. Understanding similarities and differences in acceptability of management options across different contexts promotes informed decision-making in human-deer conflicts.

865. Investigation of CRISPR-Cas9 Editing on an Arabidopsis thaliana Minichromosome

Submission Category: Natural Sciences

Author(s): Benjamin Moore
Faculty Mentor: Ek Han Tan

Abstract:
Synthetic biology is a burgeoning field that is currently underexplored. Naturally occurring minichromosomes are suitable targets to examine synthetic biology techniques. In Arabidopsis thaliana, minichromosomes are genetic artifacts left behind after centromere mediated genome elimination, a haploid induction system that has been well characterized in this species. Our goal is to show that minichromosomes can be edited with no unfavorable consequences to the organism that hosts it. CRISPR-Cas9 (CRISPR) is a tool used for precise genome editing in plants and animals. We are investigating to see if CRISPR-Cas9 can be used to modify an Arabidopsis minichromosome, which we have named Mini1a. We preformed two transformations of Mini1a plants. The first transformation of paired single guide RNAs (sgRNAs) with the nickase version of Cas9 to test if the minichromosomes can be modified. The second transformation used the same paired sgRNA with the typical Cas9 protein gene. We will perform DNA sequencing across the CRISPR sgRNA sites to determine if there were any

changes made in either case. We hope to show that that precise in planta manipulation of minichromosomes is feasible via CRISPR-Cas9 and that minichromosomes are viable platforms for chromosome engineering in plants.

866. Moved to Late Breaking Abstracts

867. Quantification of Variance and Drought Resistance of Maine Wild and high bush Blueberries

Submission Category: Physical and Mathematical Sciences

Author(s):
- Aldous Hofmann
- Pratima Pahadi

Faculty Mentor: YongJiang Zhang

Abstract:
Wild blueberries are an important crop to the state of Maine commercially and culturally that is characterized by high inter-genotypic variation both within and across two main species (Vaccinium angustifolium and V. myrtilloides) where these species have been coevolving for around 10,000 years. These blueberries grow in a rhizomatous system underneath the soil but above ground appear as a mosaic of individual genotypes where they differ in biological traits, like age, height, color and hue, phenology, and yield. Our studies suggest that these two species also differ from one another in terms of both structural and physiological traits and that these variations are due to high stem variation within the genotype compared to genotype variation across the species. Comparison of Leaf Economic Spectrum traits of blueberries species with GLOPNET species also shows that the trait relationships are not consistent and show very weak relationships. This variation again could be high stem variation within the genotype and not all LES trait relationships hold at local scales where our study site is a semi-natural agricultural system. With the change in environmental conditions over years we see that there is a shift in the species requirements and occupancy of different quantitative areas based on their requirements. It is possible that these two species have been coexisting and coevolving for a long period. Each species has its own set of requirements for environmental conditions in the field, for example, soil nutrients.

868. Production of Wood Flour from Secondary Processing Mill Residues in Maine and its Utilization

Submission Category: Natural Sciences

Author(s): Geeta Pokhrel

Faculty Mentor: Douglas Gardner

Abstract:
Maine, among the most forested states (89% coverage) in the nation has a large number of forest product producers that generate around 1.6 million tons of mill processing residues annually. However, most of the mill residues are not utilized commercially. Being home to a wood plastic composite (WPC) manufacturer in Biddeford, there is no commercial production of wood flour here and the company relies on a Canadian firm for sourcing wood flour feedstocks. Usually, the shipping cost of wood flour exceeds its actual material price and tractor trailer trucks are loaded without attaining their maximum weight limit, which consequently increases the cost of raw material for WPC manufacturing, and affects the price of finished products. Scientific research on wood flour production from mill residues is limited. In addressing the above mentioned issues, this study focused on exploring the utilization secondary processing mill residues from four wood species in Maine based on abundance and species utilized in WPC manufacture. Methodologies included laboratory work on wood flour manufacturing and material properties characterization. Besides wood flour, WPCs were manufactured and tested using wood pellets. Interviews will be carried out with industrial producers to understand the processing costs of wood flour and wood pellets. A network analyst tool in ArcGIS will be used to understand the transportation costs of these products. This study will ultimately encourage investors to establish a wood flour industry in Maine to ensure the efficient outlet of mill residues. Furthermore, WPC manufacturers would benefit from the minimization of their raw material costs that would positively impact subsequent customers.

Interdisciplinary Research

Projects 901 - 906

Interdisciplinary Research

901. Assessing Climate Change Impacts on Food Insecurity: Millinocket Case Study

Submission Category: Interdisciplinary Research

Author(s):
- Sean Driscoll
- Jared Entwistle
- Anna Olsen
- Carly Frank

Faculty Mentor: Katherine Glover

Abstract:
Food insecurity, defined as a lack of access to sufficient, safe, and nutritious food required for an active and healthy life, is a pressing issue globally. Countless factors impact food insecurity, some of which include socio-economic, environmental, and climate factors. This research will take an interdisciplinary approach to assess the impacts of recent climate changes on food insecurity at a local level through the case study of Millinocket, Maine. This project will construct a model of the town's historical state of food insecurity both from a social perspective and an economic perspective. Agricultural assessment will be done to analyze the shifts in productivity for the region's food production based on the changing climate and its effect on crop species. A historical climate analysis will be performed, focusing on variables most relevant to agriculture. These assessments will then be integrated and contextualized within the broader socio-economic framework of Maine and the United States. The findings of this research will serve to inform public education efforts relating to food insecurity within rural communities.

902. Government Deforestation Practices and Indigenous Rights

Submission Category: Interdisciplinary Research

Author(s):
- Sarah Dennison
- Beth Jackson
- Casey Olechnowicz
- Christophe Mbuye

Faculty Mentor: Katherine Glover

Abstract:
Globally, deforestation is a well understood process of industrial and government produced logging, where biodiversity loss and climate impacts are consistently highlighted as the primary externalities. These activities have had enormous human impacts however, particularly among Indigenous communities who historically and presently continue to experience natural resource extraction on their lands. This resource extraction continues historical practices of settler colonization, where settling institutions and governments continue to occupy and negatively impact Native lands and communities (Tuck and Yang 2012). This research will shed light on the seldom discussed relationship between institutional deforestation activities and the harm they bring towards Indigenous communities. Through a comparative case study analysis, we will investigate how large-scale deforestation practices replicate historical settler colonialism activities, whether governments executing logging operations follow the guidelines set out by the United Nations Declaration on the Rights of Indigenous people for "free, prior, and informed consent," and how Indigenous governance and self-determination can address future climate risk. Our four cases are the Uru-Eu-Wau-Wau Indigenous Lands in Brazil, the Batwas people of the Democratic Republic of Congo, the Waswanipi Cree of Northern Quebec, and Menominee Nation of Wisconsin. Through these cases we will illuminate deforestation in a novel way through the lens of Indigenous consent and settler colonialism, while also assessing ways in which Indigenous people can be incorporated into solutions towards biodiversity retainment and climate mitigation.

903. One-step Hydrothermal Synthesis With in Situ Milling of Biologically Relevant Hydroxyapatite

Submission Category: Interdisciplinary Research

Author(s):
- Sahar Roozbahani
- Mitchell Chesleya
- Raymond Kennard

Faculty Mentor: Michael Mason

Abstract:
Biologically relevant synthetic hydroxyapatite (HA) has become a much-desired material for use within the medical field with an emphasis on orthopedic applications. However, there are very few sources of sub-micron scale HA powders that are economical. Many current procedures to generate synthetic HA, that is both biological and chemically analogous to naturally occurring HA, tend to involve complicated synthesis procedures that are difficult to simultaneously

produce desired stoichiometric ratios and particle diameter. This paper reports the development of a one-step hydrothermal method with in situ ball milling of synthetic HA. That has the potential to be a biological substitute with similar calcium to phosphate stoichiometric ratio and particle diameter of HA found in many natural biologically occulting sources. Parameters affecting particle diameter investigated included varying ball milling media, in situ and ex situ ball milling, and simultaneous agitation. The stoichiometric ratios of the resulting powders indicated that 4-hour hydrothermal reaction time produced materials that are analogous to natural HA, confirmed from spectra acquired via Fourier Transform Infrared spectroscopy (FT-IR). X-ray diffraction and Scanning Electron Microscopy both indicate that the predominant size of primary crystallites is around ~25 nm. Particle size distributions of dried in situ ball-milled HA suggest that primary crystallites exist as aggregates, with aggregate diameters ranging between 1 and 100 μm.

904. The Use of Augmented Reality to Monitor Coastal Erosion

Submission Category: Interdisciplinary Research

Author(s):

- Nicholas Sherman
- Elijah Story

Faculty Mentor: Michael Scott

Abstract:
Understanding coastal erosion is important for climate studies, earth science, marine science, anthropology, and for general public interest. Measuring coastal erosion over time is often labor intensive and time consuming. Currently, erosion is measured in the field using physical tools such as tape measures and GPS devices. Data is typically recorded and logged with paper and pencil. With the advancement of Augmented Reality (AR) technology in smartphones, an opportunity is available to use AR, enhanced by the inclusion of LIDAR in modern smartphones, to make field measurements. Using two established base points, whose GPS coordinates have been recorded, the user can place virtual points where measurements are to be collected. The smartphone then creates a baseline in AR and projects virtual lines perpendicular to the baseline. These virtual lines, created in equal increments along the baseline, serve as the foundation for which the distances are taken and recorded over time. The measurement from the baseline to the intersection of the eroding bank is automatically calculated by visually selecting the point of intersection along the projected perpendicular line. This research into AR and the process of recording coastal erosion will not only change the way erosion is measured, it will provide the

scientific community with the ability to gather accurate, relevant data efficiently using a single public and scientific tool.

905. Understanding Indigenous Connections to Sand in Maine Through Place Names

Submission Category: Interdisciplinary Research

Author(s):

- Madeleine Landrum
- Lance Stasinski
- Hazel Cashman
- Haley Albano

Faculty Mentor: Katherine Glover

Abstract:
Most of our academic knowledge about Indigenous land use in New England is based on journals and other written accounts by European settlers. Those records lack the perspectives of Indigenous people and only explain land use post-contact. The goal of this project was to contribute towards narrowing this gap in knowledge through a literature review and synthesis of the data surrounding the history of the Penobscot people in the Penobscot Valley. We combined existing Penobscot oral histories, place names, pollen and charcoal data, anadromous fish migration patterns, and clamming site locations to reconstruct past environments along the Penobscot River and its outlet. We then translated this data into a StoryMap to build a collective story of the relationship between the Penobscot people and the living histories of the valley named for them. This research was done by placing oral histories and cultural knowledge of the Penobscot people as equal partners with western scientific knowledge, allowing us to develop a more comprehensive analysis than one ontology would allow. This map therefore enriches the scientific understanding of the Penobscot Valley and provides a robust example of the benefits of this integrative approach. We hope that this work will encourage future consultation with Indigenous populations among western scientists investigating relationships between humans and the landscape of the northeastern United States.

906. Moved to Late Breaking Abstracts

Biomedical Sciences

Projects 1001 - 1088

Biomedical Sciences

1001. The Role of McProf's ESX-like TA Cassette in M. chelonae Antibiotic Resistance

Submission Category: Biomedical Sciences

Author(s):
- Anna Schumann
- Jaycee Cushman
- Sarah McCallister
- Keith Hutchison
- Sally Molloy

Faculty Mentor: Sally Molloy

Abstract:
Pathogenic mycobacteria are the leading cause of death worldwide. Mycobacterium abscessus is the most isolated pathogen from cystic fibrosis patients and often completely resistant to antibiotics. Increased research on antibiotic resistance mechanisms is important for developing new treatments. Prophage, viral genomes integrated into bacterial genomes, contribute to virulence in most pathogens. Their role in mycobacterial virulence is not known. We showed that the naturally occurring prophage, McProf, increases the antibiotic resistance and expression of whiB7, a transcriptional activator of antibiotic resistance genes, in pathogenic Mycobacteria when exposed to stress. It has not been reported how prophage change bacterial gene expression and antibiotic resistance. We hypothesize that prophage gene products alter bacterial gene expression. McProf expresses high levels of genes in a secreted polymorphic toxin system. Polymorphic toxins are known to play a role in the bacteria's responses to stress and are known to trigger changes in gene regulation in other bacteria of the population to increase the overall population's fitness. This project aims to determine if the McProf polymorphic toxin system is responsible for altered whiB7 expression and antibiotic resistance when the bacteria are exposed to stress. We have PCR amplified the genes of the polymorphic toxin system and cloned them into an integrative mycobacterial expression plasmid. If the polymorphic toxin system is responsible for changes in antibiotic resistance and whiB7 expression, mycobacteria carrying the plasmid-encoded polymorphic toxin genes will have whiB7 expression and drug resistance profiles similar to that of mycobacteria carrying the McProf prophage.

1002. Role of the Accessory Domain on CpsA Function and Capsule Production in Group B Streptococcus

Submission Category: Biomedical Sciences

Author(s):
- Gina DiFederico
- Melody Neely

Faculty Mentor: Melody Neely

Abstract:
Group B Streptococcus (GBS) can be found in the vaginal and genitourinary tract of females, as well as the genitourinary tract of males, where it behaves as a commensal organism. However, as an opportunistic pathogen, GBS has the capability to infect the immunocompromised, making it a major threat to neonates and fetuses. The pathogen can be passed from mother to baby either in utero or during birth. The capsule, which is a polysaccharide coating on the outside of the cell, is considered the most important virulence factor in GBS. Expression of capsule plays a role in evasion of the host immune response to GBS infection. The presence of capsule on GBS depends on the CpsA protein, which is involved in the attachment of capsule to the cell wall. CpsA is a multi-functional protein containing an intracellular domain and two extracellular domains including the accessory and the LytR domains. Previous data demonstrates a small region within the accessory domain of CpsA that, when expressed separately, can have a negative effect on the amount of capsule on the cell. In this study, the deletion of the extracellular accessory domain of CpsA will help to determine the role of the domain on CpsA function and capsule production. Cell morphology analysis, capsule assays, and virulence studies will all be used to analyze results of a deletion of the accessory domain.

1003. The COVID-19 Public Health Response and Alcohol Abuse: A Comprehensive Analysis

Submission Category: Biomedical Sciences

Author(s):
- Anthony Posuniak
- Deborah Saber

Faculty Mentor: Deborah Saber

Abstract:
Focus
The COVID-19 pandemic and alcohol abuse represent significant threats to public health in the United States. This capstone seeks to provide a comprehensive analysis of what is known about SARS-COV-2, examine prior pandemic strategies, define the current pandemic mitigation efforts and their scientific efficacy, consider potential societal impacts of the response, and determine the role of the nurse practitioner (NP) as a leader in public health.

Process
Much is known about SARS-COV-2 (COVID-19) and there are decades of research on coronaviruses like SARS. The COVID-19 response was a derivation from other pandemic responses by quarantining healthy individuals and locking down the economy. Modeling and mechanistic studies support the widespread use of masks, school closures, and lockdowns, albeit with varying degrees of contrary evidence and socio-economic concerns. Prior evidence on pandemic responses and current trends indicate that mental health problems, domestic violence, and suicide rates will likely increase due to the pandemic and its public health response. Alcohol abuse is also likely to increase as a means of coping with pandemic stress and depression. NPs are well-situated to lead future public health responses due to their leadership ability, safety, efficacy, and ability to build rapport with patients.

Outcomes
The public health response to COVID-19 is having a disparate impact on low-wage and socioeconomically disadvantaged Americans. The mental health, social, and economic impacts are likely to be vast. Accordingly, the current and future pandemic responses should be narrowly tailored, protect the most vulnerable, and allocate resources accordingly.

1004. Repurposed Therapeutics for Treatment of JC Polyomavirus Infection

Submission Category: Biomedical

Author(s):
- Avery Bond
- Mason Crocker
- Michael Wilczek
- Melissa Maginnis

Faculty Mentor: Melissa Maginnis

Abstract:
Progressive multifocal leukoencephalopathy (PML) is a fatal disease of the brain caused by JC polyomavirus (JCPyV), a virus that infects 50-80% of the human population. JCPyV persistently and asymptomatically infects the kidneys of healthy individuals. In severe cases of immunosuppression, JCPyV can spread from the kidneys to the brain, resulting in PML. Since there are currently no effective treatments for PML, many individuals will quickly succumb to this disease or become severely debilitated. Therefore, continued research surrounding JCPyV infection and PML is essential. Recently, the Maginnis laboratory performed a large-scale drug screen using the National Institutes of Health Clinical Collection (NIH-CC) and assessed viral infectivity by utilizing high-throughput In-Cell Western assays. Results from the drug screen revealed that multiple FDA-approved drugs, from several drug classes, are able to reduce JCPyV infection. Categories that contained the most drug “hits” include receptor agonists/antagonists, calcium signaling-related drugs, and enzyme inhibitors. Further investigation of calcium-signaling drugs and inhibitors supports a role for calcium signaling in JCPyV infection. Potential antivirals for JCPyV infection and PML will be identified through characterization of the mechanism of inhibition of drug hits during the viral infectious cycle. Importantly, drugs in the NIH-CC have previously been approved for other uses, and repurposing existing therapeutics is an efficient method to hasten discovery of antiviral treatments.

1005. AAV9-Ighmbp2 Gene Therapy Significantly Improves Motor Performance in Severe SMARD1-like Mouse Model, nmd-em3, and CMT2S Mouse Model, nmd-em5

Submission Category: Biomedical Sciences

Author(s):
- Sarah Holbrook
- Amy Hicks
- Greg Cox

Faculty Mentor: Greg Cox

Abstract
Autosomal recessive mutations in IGHMBP2, a ubiquitously expressed DNA/RNA helicase, have been linked to childhood neuromuscular degenerative diseases (NMDs). C57BL/6J-Ighmbp2em3Cx is a SMARD1-like strain, or Spinal Muscular Atrophy with Respiratory Distress, created via CRISPR-Cas9 targeting of the IGHMBP2 gene and hereafter referred to as em3. SMARD1 is characterized by muscle weakness starting in the distal extremities and diaphragmatic paralysis leading to respiratory failure. Most patients are diagnosed in early infancy and die in early childhood. The em3 mouse has more severe muscle

atrophy than the historical SMARD1-like model (nmd2J) in the hind limb, diaphragm, and intercostal muscles. The em3 mouse model also has an average lifespan of ~3 weeks compared to the 2J's ~3 month lifespan. C57BL/6J-Ighmbp2em5Cx is a Charcot-Marie-Tooth disease type 2S model that has not impact on lifespan but does impact motor and sensory function beginning around the 4 week timepoint.
Gene therapy has shown promise in another NMD, Spinal Muscular Atrophy (SMA). In collaboration with the Meyer lab at Nationwide Children's Hospital in Columbus, OH, we are testing 2 different AAV9-Ighmbp2 vectors. Each has a different promoter with one having a Chicken β-Actin (CBA) Promoter [higher expression levels than endogenous levels] and the other having a truncated Methyl-CpG binding protein 2 (MECP2 aka P546) promoter [expression levels close to endogenous levels expressed by muscles and neurons]. We did p1 intracerebroventricular injections on em3 and em5 mutants and unaffected sibling pups to determine the efficacy of each treatment, respectively, and if there are toxic effects associated with overexpression of IGHMBP2 in wild type mice.

1006. Characterizing the Role of Prophage on whiB7 Expression and Antibiotic Resistance in Mycobacterium chelonae

Submission Category: Biomedical Sciences

Author(s):
- Jaycee Cushman
- Emma Freeman
- Sarah McCallister
- Anna Schumann
- Keith Hutchison
- Sally Molloy

Faculty Mentor: Sally Molloy

Abstract:
Mycobacterium abscessus causes lung and disseminated infections that are most common among immunocompromised individuals. It is the most intrinsically antibiotic-resistant species known, making infections difficult to treat with a success rate of only 45%. While some extensively resistant isolates are caused by mutations in drug targets, others appear to be a result of increased intrinsic drug resistance. Common among these strains is presence of integrated viral genomes (prophage) that are known to contribute to fitness and antibiotic resistance in other pathogens but whose roles are largely unknown in mycobacteria. We have demonstrated that the presence of an M. abscessus cluster R prophage, McProf, in M. chelonae, increased resistance to antibiotics,

such as amikacin, relative to strains lacking the prophage. The presence of McProf also enhances amikacin resistance in response to sub-lethal concentrations of antibiotics, or other cellular stresses such as infection by a second phage, BPs. Relative to strains carrying only one of the prophage or no prophage, the strain carrying two prophages, BPs and McProf, had the highest amikacin resistance. This strain also showed increased expression of the transcriptional activator, whiB7, which promotes expression of intrinsic antibiotic resistance genes. This work suggests that prophages play a role in increasing intrinsic antibiotic resistance and stress adaptation in pathogenic mycobacteria. Given that most pathogenic mycobacteria carry one or more prophages and encounter drug gradients in tissues during infection, characterizing how prophages regulate antibiotic resistance genes and adaptation to stresses will provide insight for developing more effective therapies for mycobacterial diseases.

1007. Discovering Virulence Factors of Candida albicans that Affect Host Immune Responses

Submission Category: Biomedical Sciences

Author(s):
- Emma Bragdon
- Bailey Blair
- Nnamdi Baker
- Robert Wheeler

Faculty Mentor: Robert Wheeler

Abstract:
Candida albicans (C. albicans) is a commensal yet opportunistic pathogen. It is typically found in the oropharyngeal, gastrointestinal, and reproductive tract of humans. While healthy adults are not infected by the pathogen besides the common vaginal yeast infection, immune-compromised individuals such as those going through chemotherapy and bone marrow transplants are susceptible to life-threatening infection with mortality rates reaching up to 40%. Understanding the mechanisms as to how this pathogen causes disease may help us develop new strategies to prevent and treat these lethal infections. We sought to identify new virulence genes in C. albicans that regulate innate immune response. Since hyphal growth is tightly linked to virulence for C. albicans, we reasoned that novel immune evasion genes might be identified as mutations which affect hyphal growth or virulence, but not both. Previous work in the Wheeler Lab identified 133 mutants in the Noble mutant library collection which had previously been characterized to encode known secreted factors, or be required for hyphal growth or virulence, but not both. Using a zebrafish hindbrain infection model, where it is known that survival is closely linked to

rapid immune responses, mutant C. albicans strains lacking single genes were injected into the hindbrain of the zebrafish, and infection was observed and analyzed to draw conclusions on virulence factors that are most important in C. albicans infection. This method identified two genes, CHT2 and ORF19.5547, that appear to be important in virulence. Further directions include determining the mechanisms by which these genes enhance virulence.

1008. Understanding the Role of Perivascular Adipose Tissue Differentiation in Cardiovascular Disease

Submission Category: Biomedical Sciences

Author(s):
- Caitlin Stieber
- Joshua Boucher

Faculty Mentor: Lucy Liaw

Abstract:
Obesity is a major risk factor for cardiovascular disease. Cellular interactions between adipose tissue and the vasculature may explain this link. Perivascular adipose tissue (PVAT) surrounds most vessels and exerts a paracrine effect on the underlying blood vessel. In metabolically healthy individuals, PVAT secretes factors that decrease constriction and expansion of smooth muscle in the vessel. However, in metabolic disease, PVAT-secreted factors increase constriction and expansion of the smooth muscle leading to restricted blood flow and disease. We study two human populations with different levels of cardiovascular disease to assess PVAT phenotype. Our interest is how the PVAT phenotype varies within populations and how this is regulated by the trafficking molecule RAB27A. We hypothesize that there will be differences in BMI, gene, and protein expression between the two populations. PVAT and subcutaneous adipose tissue (SubQ) were collected from donors undergoing coronary artery bypass graft (CABG) or those underdoing mitral valve repair (VR). We assessed demographic and clinical differences in the donor populations. Using single nuclei RNA sequencing and immunoblot we assessed the expression of RAB27A and adipose markers. Additionally, pre-adipocytes were isolated, grown in vitro, and assessed using immunoblot. The average BMI and diabetes prevalence was increased in the CABG population, indicating they are more likely to be metabolically unhealthy. RAB27a gene expression was increased in donors with a lower BMI, while protein expression was decreased. Moving forward, we will continue to examine molecular differences between donors, as well as strive to understand Rab27a's mechanistic control of adipose differentiation.

1009. Understanding the Mechanism of Cancer Treatment Induced Ovarian Toxicity

Submission Category: Biomedical Sciences

Author(s):
- Monique Mills
- Chihiro Emori
- Parveen Kumar
- Zachary Boucher
- Ewelina Bolcun-Filas

Faculty Mentor: Ewelina Bolcun-Filas

Abstract:
Genotoxic cancer treatments - such as radiation - induce DNA damage, preferentially killing cancerous cells but can also kill healthy cells. Primordial follicles (PFs), a finite population of ovarian follicles containing immature oocytes, are highly susceptible to DNA damage. Depletion of PFs through cancer treatment induced DNA damage can cause premature ovarian failure and infertility. Existing fertility preservation methods are invasive, delay cancer treatment, and are insufficient for prepubescent females. The goal of this project is to elucidate the DNA damage response in PFs to identify targets for a non-invasive pharmacological inhibition strategy to preserve ovarian function without delaying cancer treatment. Our lab previously showed that CHK2 kinase and its downstream target TAp63 are key mediators of the DNA damage response in oocytes. Inhibition of CHK2 or TAp63 activity improved PF survival after low-dose radiation. However, at high-dose radiation, TAp63-/- mice, but not Chk2-/-, were depleted of PFs indicating a TAp63-independent mechanism. Oocyte's response to DNA damage is still poorly understood. To identify factors and processes involved in DNA damage induced oocyte elimination, we conducted single cell sequencing of irradiated and non-irradiated ovaries from wild type and Chk2-/- mice. We observed a strong CHK2-dependent response in oocytes and identified three novel factors that may be mediators or targets of this response. Defining the role of these proteins in oocytes, in response to radiation induced DNA damage, will allow us to design a pharmacological inhibition strategy to prevent premature ovarian failure and infertility in female cancer survivors.

1010. Characterization of Dual Specificity Phosphatase 1 (DUSP1) Activity and the Immune Response during JC Polyomavirus Infection in Primary Human Astrocytes

Submission Category: Biomedical Sciences

Author(s):
- Aiden Pike
- Michael Wilczek

Faculty Mentor: Melissa Maginnis

Abstract:
The human JC polyomavirus (JCPyV) causes a persistent, asymptomatic infection in the kidneys in up to 80% of the population. In immunocompromised individuals, JCPyV can spread to the brain and cause the fatal, demyelinating disease known as progressive multifocal leukoencephalopathy (PML). The method by which JCPyV causes PML remains poorly understood and there are no current treatments for the disease. Immortalized brain cells known as SVGAs have been utilized to define the interplay of cellular signaling pathways and viral infection; however, preliminary data suggests that JCPyV infection in normal human astrocytes (NHAs) can also lead to the activation of innate immune response components, not recognized during viral infection of SVGAs. Previous research has demonstrated that JCPyV infection in the kidneys leads to an interferon response in the host, resulting in an asymptomatic infection, yet these immune responses have not been well characterized in the brain. Dual specificity phosphatase 1 (DUSP1) is a well-described protein known to regulate a cellular pathway used by JCPyV, but is also involved in the immune response during infection by other viruses. DUSP1 has known interactions with genes that specifically activate downstream immune response pathways, which can play a key role in the outcome of viral infection. Utilizing bioinformatic tools such as EdgeR, STRING DB, and other statistical analyses we have further characterized the differential expression of genes involved in the immune response. This research will further our understanding of cellular factors that drive JCPyV infection, the immune response, and identify potential targets for antiviral treatments.

1011. Identification of Potential Antiviral Drug Targets in JC Polyomavirus Infection

Submission Category: Biomedical Sciences

Author(s):
- Nicholas Leclerc
- Avery Bond
- Mason Crocker
- Melissa Maginnis

Faculty Mentor: Melissa Maginnis

Abstract:
JC Polyomavirus (JCPyV) infects up to 80% of the global population and causes a persistent, asymptomatic infection of the kidneys. This progresses to a lytic infection of astrocytes and oligodendrocytes in immunocompromised individuals, resulting in development of the fatal neurodegenerative disease known as progressive multifocal leukoencephalopathy (PML). Currently, there is no available standard therapy for the treatment of PML in clinical settings. Recent development of a high-throughput In-Cell Western (ICW) drug screen allows for the analysis of a substantial number of pharmaceuticals and their effect on viral infection. This method utilizes a high-throughput infrared scanner to quantify the percentage of virus-infected cells in culture after administration of over 700 drugs from the NIH Clinical Collection and subsequent exposure to JCPyV. Through normalizing these ratios and determining z-scores, the Maginnis lab has identified drugs that significantly reduce viral infection and prioritized drugs for further characterization based on their mechanisms of action. Identification of the characteristics of these drugs and analysis of preliminary data will allow for their prioritization in terms of their relevance to JCPyV infection. Through cell-based assays, the effects of these drugs on JCPyV infection will be more accurately elucidated, and the step in the JCPyV infectious cycle that is specifically affected by the treatment will be determined. Overall, this research could serve as the platform for identification of novel antiviral treatments to treat or prevent PML.

1012. Temporal Dynamics of Viral Load and False Negative Rate Influence the Levels of Testing Necessary to Combat COVID-19 Spread

Submission Category: Biomedical Sciences

Author: Katherine Jarvis

Faculty Mentor: Joshua Kelley

Abstract:
The world wide outbreak of COVID-19 in March 2020 forced college campuses to close and resort to online learning for the remainder of the Spring 2020 semester. But for the Fall 2020 semester, colleges and universities looked toward computational predictive models to assess the amount of testing and preventative measures in order to open college campuses without causing an outbreak. Some predictive models do not take into account the infectivity and false negative rate of the test changing over time based on the day of symptom onset. In order to prove dynamics of viral spread are crucial in simulating an epidemiology model, we developed a stochastic agent based model of COVID-19 spread in a university sized population and determined the amount of testing required to not cause an outbreak. The amount of testing required to prevent an outbreak with uniform infectivity and false negative rate of testing

distributions was significantly less than the model accounting for the dynamics of infectivity and false negative rate. From this comparison, it shows the viral dynamics is an important factor when modeling viral spread.

1013. Defining the Role of G-Protein Receptor Kinase 2 in JC Polyomavirus Entry

Submission Category: Biomedical Sciences

Author(s):
- Paige Giffault
- Colleen Mayberry
- Kashif Mehmood

Faculty Mentor: Melissa Maginnis

Abstract:
JC polyomavirus (JCPyV) is a human pathogen that targets kidney epithelial cells, resulting in an asymptomatic infection of the kidneys in healthy individuals in over half of the world's population. However, in immunocompromised individuals, the initial infection in the kidneys can progress to a lytic infection in the brain through the dissemination of JCPyV into the central nervous system. Within the central nervous system, JCPyV infects and destroys human glial cells, astrocytes and oligodendrocytes, leading to the development of progressive multifocal leukoencephalopathy (PML), a fatal disease for which there is no current treatment. There is a limited understanding of the mechanisms that JCPyV uses to enter these target glial cells within the central nervous system. Previous research by Mayberry et al. has shown that serotonin 5-hydroxytryptamine subfamily 2 receptors (5-HT2Rs), G-protein coupled receptors (GPCRs), mediate JCPyV entry into target cells by clathrin-mediated endocytosis. JCPyV internalization and infection also requires the scaffolding protein β-arrestin, which has been shown to bind to a conserved amino acid motif, Ala-Ser-Lys (ASK), within the intracellular loops of the 5-HT2Rs. G protein receptor kinases (GRKs) are known to phosphorylate serine and threonine residues on G-protein coupled receptors, leading to the recruitment of scaffolding proteins such as β-arrestin. The aim of the research is to explore the role of GRK2 in the initiation of JCPyV entry by mediating the interactions between the ASK motif within the 5-HT2Rs and the β-arrestin scaffolding protein through quantitative biochemical and confocal microscopy-based analyses. The results of this research will provide a deeper understanding of the complex mechanisms involved in JCPyV entry into target cells and could highlight potential targets for therapeutic approaches in the treatment or prevention of PML.

1014. Multiscale Image Colocalization

Submission Category: Biomedical Sciences

Author(s): Jeremy Juybari

Faculty Mentor:
- Andre Khalil
- Karissa Tilbury

Abstract:
The increase in quality and quantity of biomedical images led to frequent use of Pearson's Correlation Coefficient (PCC) for image colocalization, a common metric for quantifying overlap between a pair of images. In practice, PCC is often used with two-photon excitation microscopy data. Our previous work explored some fallbacks of PCC such as misleading PCC values when there is no overlap between images. By investigating Gaussian blurring at multiple size scales in conjunction with PCC we added a whole new analytical dimension by developing a multiscale version of the PCC. Our proposed approach mitigates limitations of the traditional PCC approach by providing a series of statistics rather than a single point from PCC. The multiscale PCC approach is a flexible tool, developed with the open-source mindset in FIJI and Python. Specifically, we found that when blurred, fiber width and approximate separation distance could be determined using the minimum measured PCC value across blurring scales.

1015. Spatial Frequency Domain Imaging Applications in Polyneuropathy

Submission Category: Biomedical Sciences

Author: Christian Crane

Faculty Mentor: Karissa Tilbury

Abstract:
Our research is focused on yielding better results for patients in the form of early detection and/or screening for polyneuropathy. We will be collecting imaging data of study participants' feet using Spatial Frequency Domain Imaging (SFDI) to analyze tissue perfusion. SFDI projects distinct spatial patterns of visible and near infrared light onto tissue and images of these patterns and the tissue are captured using a camera. These images contain information about tissue scattering and absorption properties which can be separated. The absorbed light is then used to calculate the amount of oxy/deoxyhemoglobin in the tissue as a measure of tissue perfusion.

Altered tissue perfusion is a key factor in the development of diabetic neuropathy. In this study, we build upon study design protocols that measured pressure and temperature differences in normal and diabetic patients during prolonged periods of standing. Here we are building upon previous studies in which tissue metrics were measured during prolonged periods of standing Furthermore, other literature has found that diabetic patients on average take fewer steps during a single day. In this preliminary study, we seek to observe and quantify tissue perfusion differences between healthy and diabetic study participants during a series of defined tasks including standing, walking, sitting, and reclining to determine if there are transitory differences that may be used to detect early alterations in tissue perfusion which may provide opportunities for development of new therapeutics.

1016. Effects of Oral-care Antimicrobial Cetylpyridinium Chloride on Tyrosine Phosphorylation: A Potential Mechanism for Mast Cell Inhibition Assessed via In-Cell Western

Submission Category: Biomedical Sciences

Author(s):
- Jessica Bruno
- Bailey West

Faculty Mentor: Julie Gosse

Abstract:
Cetylpyridinium chloride (CPC) is a quaternary ammonium salt antimicrobial found in many oral-care products such as Colgate Total mouthwash and toothpaste. There are no published studies on CPC effects on the immune system; however, the Gosse laboratory recently found that this antibacterial agent, ironically, interferes with the functioning of the mammalian immune cell type mast cells. Mast cells are dispersed throughout human tissues and are involved in many diseases and physiological processes. Mast cell degranulation occurs following a cascade of tyrosine phosphorylation events of various enzymes which contain charged protein motifs such as Src homology 2 (SH2) domains. We hypothesize that the positively charged CPC may interfere electrostatically with these enzymes. To analyze CPC effects on the tyrosine phosphorylation cascade, we will utilize an In-Cell Western (ICW) assay which is a high-throughput alternative to Western blotting. We are developing an In-Cell Western assay for use in rat basophilic leukemia (RBL-2H3) mast cells using an anti-phosphotyrosine primary antibody. Optimization of these experimental details will ultimately allow us to determine whether CPC interferes with early tyrosine phosphorylation events in the mast cell degranulation

pathway, shedding light on the mechanism by which this popular antimicrobial inhibits mast cell function.

1017. Genetic Sequencing of CYP2C19 and CFTR Mutations and Their Application to Personalized Medicine

Submission Category: Biomedical Sciences

Author(s):
- Rebecca Collins
- Aiden Pike
- Claire Bourett
- Claire Nowak
- Michaela Gervais
- Paige Giffault
- Dnry Sato
- Bruce Stanton

Faculty Mentor: Benjamin King

Abstract:
Whole genome sequencing allows for the development of individual drug therapies for those resistant to standard treatment, in a practice known as personalized medicine. Personalized medicine based on an individual's DNA can be particularly useful for those with genetic diseases like cystic fibrosis (CF). The cystic fibrosis transmembrane conductance regulator (CFTR) is a protein responsible for transporting chloride ions across epithelial cell membranes. Mutations in the CFTR gene can lead to symptoms associated with CF. CYP2C19 is a cytochrome P-450 enzyme responsible for metabolizing at least 10% of pharmaceuticals. Mutations in this gene can alter drug metabolism capabilities, including those used to treat CF. This research analyzed patient genomic DNA for mutations in the CYP2C19 enzyme, and the dF508 and M470V mutations in the CFTR protein. DNA was extracted from the sputum of a diverse group of 16 people at Dartmouth; the samples underwent PCR, a restriction enzyme digest, and Sanger sequencing. Data analysis showed no indication of the dF508 mutation in patient sampling; however, the M470V mutation appeared in at least one allele for each patient. For CYP2C19, results were more varied, including mutated and unmutated genes. These results suggest that genetic mutations, even within a small sample size, are common. On this basis, it is advisable that whole genome sequencing and personalized medicine become more widely available and affordable. Future research should be done into other mutations that may cause drug resistance and an experiment with a larger sample size to assess the greater need for personalized medicine.

1018. Evaluation of the Changes of Nerve Function Following a Sciatic Nerve Crush in CD137 Ligand Knockout Mice Using Electromyography Measures

Submission Category: Biomedical Sciences

Author(s): Rebecca Peters

Faculty Mentor: Ling Cao

Abstract:
The sciatic nerve crush (SNC) model is a widely used rodent model for neuropathic pain and studying nerve regeneration following peripheral nerve injury. Our lab is currently investigating the role of CD137 ligand (CD137L) in the peripheral nerve injury-induced neuropathic pain-like behaviors using SNC. The long term goal is to identify drug targets for treating peripheral neuropathies. Behaviorally, CD137L knockout (KO) mice have shown reproducible reduction of mechanical hypersensitivity and faster sensory and motor functional recovery following SNC compared to wild type (WT) C57BL/6 mice. To obtain an objective, quantitative assessment of SNC-induced neuropathy that will be used to further delineate the role of CD137Lin this process, we have begun testing with an electromyography measure along the sciatic nerve. Using the UltraPro S100 from Natus Neurology we have established a working protocol and will start to conduct preliminary measurement with CDL137L KO mice following both SNC and sham surgery. Both CD137L KO naive mice and CD137L positive mice will be included as controls. Nerve conduction velocity will be determined by stimulating both proximal and distal to the crush site. Both response latency and maximal combined action potential will be recorded. Measurements will be taken before surgery, and at days 1, 3, 7, 10, 14, 17, 21, 28, 35, 42, 49, 56, 63, 70 and 77, which are the same sampling times as our previous behavioral tests. We expect to observe a reversal or reduction of SNC-induced decrease in nerve function in CD137L KO mice compared to CD137 positive mice.

1019. Macrophage Response to Bone Marrow Adipocyte Expansion in C57BL/6J Mice

Submission Category: Biomedical Sciences

Author(s):

- Samantha Costa
- Gisela Pachón-Peña

Faculty Mentor: Clifford Rosen

Abstract:
Adipose expansion is a characteristic feature of aging as well as obesity, but little is known how adipocyte expansion effects immune cell function within the bone marrow (BM). BM adipocytes secrete adipokines, such as adiponectin, leptin, resistin, and IL-6 that regulate immune response and inflammation. Within the BM, macrophages play a critical role in the resolution of inflammation through phagocytosis and immunomodulation. In this study, 8-week-old male C57BL/6J mice were fed a high fat diet (HFD, 60 kcal% fat) or chow diet (control) for 12 weeks. PIXImus body composition scans revealed HFD males had significantly more fat mass and percent fat than the controls ($p<0.0001$ and $p<0.0001$, respectively). Glucose tolerance testing showed HFD caused increased fasting blood glucose levels and a significant decrease in the overall glucose handling ($p<0.05$). Femoral microCT analysis showed no significant changes in trabecular and cortical bone parameters in the HFD males. Gene expression of BM adipocytes revealed significant increases in TNF-alpha and IL-6. Macrophage specific genes, SEMA3E/PLEXID1 and F4/80 were also significantly increased which indicated macrophage migration and infiltration to the BM ($p<0.05$ and $p<0.001$, respectively). Interestingly, we observed a significant decrease in resisitn gene expression from the BM adipocytes ($p<0.01$). This may be due to resistin activating the transcription of pro-inflammatory cytokine genes, resulting in the observed increase in TNF-alpha. Our data suggests BM adipose expansion increases macrophage infiltration in this specific niche. Further analysis is needed to understand how adipocyte expansion affects macrophage function and if macrophage pliability may provoke BM tissue inflammation.

1020. Antioxidant Effects of Winterberry Leaf Extract

Submission Category: Biomedical Sciences

Author(s):
- Cara McKinnon
- Brendan Moline
- Weaam Al Hallaf
- Brian Perkins
- Sam W. Caito

Faculty Mentor: Jennifer Newell-Caito

Abstract:
The holly plant genus Ilex contains 15 species native to North America. Native American tribes in the Northeast have historically used Ilex verticillata or winterberry leaves as a medicinal tea. For that reason, it was hypothesized that these winterberry leaves may have antioxidant

properties. Polyphenols are secondary metabolites in plants which have been recently explored as antioxidants. Epidemiological studies have shown that long-term consumption of diets rich in plant polyphenols offer protection against development of cancers, cardiovascular diseases, diabetes, osteoporosis, and neurodegenerative disease. A polyphenolic extract was created by drying and distilling the winterberry leaves and the total phenolic content (TPC) was determined to be 524.45 ± 1.82 μg gallic/mL of extract. Using C. elegans as an in vivo model organism, a survival curve using the extract yielded an LD50 of 5.87%. Using this data, worms were pre-treated with 1/10%, 1%, and 5% extract and then the known oxidants manganese(II) chloride ($MnCl_2$) and juglone. The antioxidant effect of the extract was examined by measuring total reactive oxygen species (ROS). In the presence of the extract, there was a two-fold dose-dependent decrease in the total ROS generated with $MnCl_2$, and a significant reduction in total ROS generated in the juglone treatments. These are the first results suggest that the polyphenolic compounds in winterberry leaves act as antioxidants in vivo.

1021. Role of Non-Coding RNAs in Adaptation to Environmental Stressors Through the Study of Natural Populations

Submission Category: Biomedical Sciences

Author(s):
- Kayla Barton
- Adrienne Kovach
- Brian Olsen

Faculty Mentor: Benjamin King

Abstract:
The long-term goal of our research is to understand the genomic architecture of adaptation to environmental stressors. The ability to maintain cellular homeostasis under a spectrum of stressors is critical to survival. Tidal marsh sparrow species have adapted to live in a harsh environment relative to inland species. We are studying three tidal marsh and three inland sparrow species to determine which genes and pathways are under selection in tidal marsh populations using comparative genomics, population genomics, and transcriptomics. MicroRNAs (miRNAs) are small non-coding RNAs that regulate gene expression of target genes. The set of miRNAs in animals is proportional to organismal complexity. As such, they can be used as characters to study evolution. Prior studies have examined the differences in miRNAs between broad ranges of taxa. We aim to determine whether the sets of miRNAs differ among a group of closely related species, allowing us to better understand the contemporary evolution of these species. In addition we will study sequence variation among individuals in two populations of introgressed Saltmarsh and Nelson's sparrows to look for evidence of selection in

miRNA loci. This will be done by opportunistically sampling sparrow chicks, extracting RNA, sequencing small RNA, annotating miRNAs, analyzing sequence variation, and comparing miRNA between species. To our knowledge, this would be the first study to examine the evolution of miRNAs among these species.

1022. Investigation of the Extracellular Matrix in DMD Zebrafish Under Inactive and Endurance Exercise Treatments

Submission Category: Biomedical Sciences

Author(s):
- Kodey Silknitter
- Elisabeth Kilroy
- Benjamin King
- Clarissa Henry

Faculty Mentor: Clarissa Henry

Abstract:
Duchenne Muscular Dystrophy (DMD) is a debilitating neuromuscular disease that affects roughly 250,000 people globally. This disease arises from mutations in the dystrophin gene, which produces a protein responsible for linking actin filaments to the extracellular matrix (ECM). Individuals diagnosed with DMD present muscle wasting and face few treatment options to combat the disease, being advised to not exercise and stay inactive. While it is known that, in healthy individuals, inactivity is damaging to muscle structure and health, less is known for patients with DMD. We investigated the role of inactivity and exercise (eNMES) in a zebrafish model that presents the DMD phenotype. This study specifically looks at the impacts inactivity and eNMES have on the ECM. We hypothesize that zebrafish that undergo inactivity treatment will show poorer ECM structure and homeostasis than their eNMES counterparts. To investigate this, we used a combination of bioinformatic and molecular techniques. Using RNA-sequencing of both wild-type and DMD mutant zebrafish under both inactive and eNMES conditions, we noticed differential regulation in several genes associated with the ECM. Concurrently, we are also using immunohistochemical staining and high-resolution, confocal imaging to look at muscle and ECM structure of both wild-type and DMD mutant zebrafish under either inactive or eNMES conditions. We expect to find that wildtype and DMD zebrafish that have undergone inactivity treatment will have poorer muscle and ECM structure than their eNMES counterparts. These findings will broaden the field of knowledge of DMD and could potentially lead to future therapies.

1023. **Investigating the Presence of Putative RNA Thermometer-like Structures in the Zebrafish (Danio rerio) Mitochondrial Genome.**

Submission Category: Biomedical Sciences

Author(s): Abigail Muscat

Faculty Mentor: Nishad Jayasundara

Abstract:
Bacterial RNA thermometers (RNATs) help to regulate the creation of heat-shock protein (Hsps), cold-shock proteins, and virulence factors in bacteria. These RNATs are typically found upstream, in the 5'-UTR (5'-untranslated region) of heat shock genes in mRNAs. Two common groups of bacterial RNATs are ROSE (repressor of heat-shock gene expression) and fourU elements. Described as hairpin structures, with both zipper and switch-like compositions, these RNATs are vital in combating cellular damage caused by drastic temperature changes and in maintaining cellular homeostasis. In eukaryotes, small heat shock proteins have been suggested to aid the mitochondria by providing cardio-protection and protection against cellular injury, oxidative stress, and pathogens. However, these proteins are not in the mitochondria and are instead transported from the nucleus. Since evolutionarily mitochondria originated in bacteria it is possible that thermometer-like structures were retained in the mitochondrial genomes. This project aims to investigate whether thermometer-like structures can be found in the D. rerio mitochondrial genome. NCBI database searches and BLAST analyses were used for characterizing sequence similarity of existing bacterial RNATs and for comparing structures to the D. rerio mitochondrial genome to identify sequence homology. If structures are found in the mitochondria, the next step will be to investigate downstream mitochondrial genes and look for any indication of functional significance.

1024. Description of A Novel CRISPR Vertebrate Model of Dolichyl-Phosphate Mannosyltransferase 3-Associated Secondary Dystroglycanopathies

Submission Category: Biomedical Sciences

Author(s): Claire Schaffer

Faculty Mentor: Clarissa Henry

Abstract:
Muscular dystrophies are a devastating group of genetic diseases that cause muscle wasting and weakness in patients. A subset of these, secondary dystroglycanopathies, occur when there are defects in the glycosylation, or sugar-residue modification, of α-dystroglycan (αDG). A-DG is a transmembrane protein essential in anchoring muscle tissue. Glycoside chains extending off the sides of αDG allow it to interact and bind with laminin in the extracellular matrix. This association is integral in enabling the muscle to generate force without tearing. Dolichyl-phosphate mannosyltransferase 3 (DPM3) is a protein within the glycosylation pathway. When DPM3 is mutated, it cannot perform its job properly and carriers of these mutations can develop muscular dystrophy. DPM3 mutations, and secondary dystroglycanopathies in general, are an understudied and mysterious group of diseases. They vary in expression and severity, but there is no cure. The Henry lab has developed a line of CRISPR-Cas9 modified zebrafish to model DPM3-related secondary dystroglycanopathies. We were able to uncover structural and functional changed between the wild type and mutant fish through several metrics. Birefringence microscopy let us follow disease progression over time, phalloidin imaging allowed us to look at muscle fibers, and movement tracking allowed us to quantify and compare average muscle usage between the groups. Combined with sequencing data, we were able to develop a clear picture of our DPM3 mutant zebrafish phenotype. Going forward, we will use this model to pursue future studies to test therapies for DPM3-related secondary dystroglycanopathies that will support the damaged tissue at the molecular level.

1025. Investigating the Cell-Type Dependent Host Signaling Mechanisms of JC Polyomavirus

Submission Category: Biomedical Sciences

Author(s):
- Remi Geohegan
- Michael Wilczek

Faculty Mentor: Melissa Maginnis

Abstract:
Characterizing the host genes needed for viral replication is essential to the study of infection and disease progression. JC polyomavirus (JCPyV) causes a persistent, asymptomatic infection of the kidneys in up to 80% of the population. In immunocompromised individuals the virus can reactivate, traffic to the brain, and cause progressive multifocal leukoencephalopathy (PML), a disease that destroys glial cells and is fatal. JCPyV only infects human cells, limiting research of PML to cell culture glial cell models. My project investigates cell signaling mechanisms of

JCPyV in primary normal human astrocytes (NHAs) compared to immortalized cells. JCPyV activates extracellular regulated kinases (ERKs) within the mitogen activated protein kinase (MAPK) pathway, a cell signaling pathway exploited by viruses for its role in cellular differentiation and proliferation. Research from the Maginnis laboratory demonstrated that during JCPyV infection, ERK was activated early in immortalized cells, however preliminary evidence suggests that ERK activation was delayed in NHAs. The goal of this project was to further validate these findings, quantifying ERK protein expression with increasing JCPyV infection and through infectivity assays, following the treatment of chemical activators to ERK. Preliminary data suggests that increasing JCPyV infection may not enhance ERK activation in NHAs. Additionally, upregulating ERK using chemical activators may influence JCPyV infection in NHAs compared to infection in immortalized cells. This data corroborates initial findings; during JCPyV infection of NHAs the MAPK-ERK pathway is regulated and exploited differently in NHAs providing a deeper understanding of how JCPyV reprograms these cells and results in the fatal disease.

1026. Surface Acoustic Waves for Manipulation of Fluid and Biomolecules

Submission Category: Biomedical Sciences

Author(s):
- Joel Tewksbury
- Caitlin Howell
- Mauricio Pereira da Cunha

Faculty Mentor: Caitlin Howell

Abstract:
Small biomolecules can be challenging and expensive to isolate and manipulate, but they may be the key for developing more efficient diagnostic tools for pancreatic cancer. Pancreatic cancer has a survival rate of less than 5% five years after diagnosis. For this reason, the research and establishment of cheap, effective screening tools are highly desired. One promising method of screening is separating and identifying biomarkers in a patient's blood that are indicative of pancreatic cancer. The purpose of this project is to develop a system using surface acoustic waves (SAWs), in conjugation with microfluidics and surface functionalization, to separate and manipulate small biomolecules in blood. The separation and manipulation are achieved by passing the targeted fluidic material, in this case blood, through a microfluidic channel on top of a SAW device. The SAWs are generated by using an array of interdigital transducers (IDTs) photolithographically printed on a piezoelectric crystal to convert the electrical signal into acoustic waves. The SAW propagates, guided at the top surface of the material, and interacts

with the fluid, exerting a force on the fluid and on particles in solution. The possibility of using open microfluidics to manipulated fluid droplets as an alternative to a continuous flow stream in a microfluidic channel was also explored. The surface was functionalized using a fluorinated silane and coated with a fluorinated oil to create a SLIP surface for easy droplet manipulation. The results of implementing this procedure showed significant dewetting of the oil layer, but despite this when properly coated did provide a surface hydrophobic enough to allow for easy droplet sliding, and thus easy manipulation of droplets on the surface. This procedure combined with a heat source allows for concentration of particles at specific locations for easier particle detection. The development of the device discussed is expected to yield a new and consistent approach to pancreatic cancer screening methods that is both compact and extremely sensitive to facilitate the detection of pancreatic cancer long before symptoms appear.

1027. Characterizing the Role of IRS1/2 in Osteocyte Differentiation and Function in Bone Development

Submission Category: Biomedical Sciences

Author(s):
- Vivin Karthik
- Victoria van Berlo
- Li Tian
- Jennifer Daruszka
- Victoria DeMambro

Faculty Mentor: Anyonya Guntur

Abstract:
Osteocytes are the most abundant cell type in skeletal bone and are present in the bone matrix. They form a network for sensing mechanical cues coming from the bone remodeling units which involve both the osteoblasts and osteoclasts. Osteocytes have been studied in the context of mechano-transduction biology and signaling, there are very few studies elucidating the role of osteocytes in metabolic homeostasis and bioenergetics. Insulin receptor substrate proteins 1 and 2 (IRS1/2), are scaffolding proteins involved in insulin and insulin growth factor 1 (IGF1) signaling necessary for the anabolic regulation of bone. In this study, we aim to delineate the role of IRS1/2 in osteocyte metabolism and bioenergetics by knocking out IRS1/2 in osteocytes in mice using osteocyte-specific Dentin Matrix Protein (DMP1) Cre. Preliminary results through dual X-ray absorptiometry to measure bone mineral content in 9-week-old mice show that Cre-specific males and females have reduced areal and femoral bone mineral density (BMD) compared to wildtype (wt) littermates. However, there were no changes in the fat mass and lean

mass parameters. Micro CT analysis of aged mice that measure trabecular bone, cortical bone, and mechanical strength parameters show that Cre-specific males and females have reduced BMD, trabecular thickness, cortical area, cortical thickness, and polar moment of inertia (pMOI) compared to wildtype (wt) littermates. Future studies would evaluate the bioenergetic profile of the IRS1/2 knockout osteocytes in vitro by analyzing the metabolic flux of glycolysis and oxidative phosphorylation, in conjunction with identifying the genes involved in metabolism in the insulin signaling pathway of osteocytes.

1028. Design of Theoretical Modeling to Support a Regenerative Radiation Shield for Deep-Space Exploration

Submission Category: Biomedical Sciences

Author(s):
- Benjamin Chasse
- Ainslie Allen
- Damon Williams
- Riley Drummond

Faculty Mentor: Caitlin Howell

Abstract:
Radiation shielding is an essential consideration for human deep-space exploration, as prolonged exposure serious threats to critical human-physiological processes. Current solutions include the use of materials like polyethylene to scatter cosmic radiation; however, these materials have a restricted lifetime as an effective radiation shield. To address this issue, research shows that the fungus Cladosporium sphaerospermum can act as a living and regenerative protective layer, capable of absorbing harmful radiation in a deep-space environment. Yet to create a continuous growth system, C. sphaerospermum would need a continuous supply of nutrients. In this project, we theoretically optimize such a system, building on our previously-developed vascularized networks. Optimization of the vascular system was performed in Solidworks and COMSOL to generate predictive models for rapid experimentation. The minimum nutrient delivery rate for sustaining C. sphaerospermum growth was determined to be 1.11*10-9 mol*mm-2*s-1 and the minimum surface-level concentration was found to be 1.1*10-4 mol/m3. To meet these needs and minimize wasteful diffusion of nutrients, the geometric configurations of the vascular channels and the concentration of the nutrient diffused from the channels were controlled. By adjusting these two variables, many theoretical models were generated and compared, and the best performing model was selected on its ability to sustain only the minimum livable conditions for C. sphaerospermum. Thus, with an optimized model of nutrient delivery, this work has set the

foundation for a living and regenerative radiation shield to protect astronauts in deep-space exploration.

1029. Caloric Restriction and Fasting Diets have Negligible, or Potentially Damaging, Effects on Cognition in Diversity Outbred Mice

Submission Category: Biomedical Sciences

Author(s):
- Andrew Ouellette
- Niran Hadad
- Andrew Deighan
- Kristen O'Connell
- Adam Freund
- Gary Churchill

Faculty Mentor: Catherine Kaczorowski

Abstract:
Aging remains the greatest risk factor for developing Alzheimer's disease (AD). Given the projected increase in lifespan across the globe, the risk of developing AD is expected to increase, along with significant economic and social burden. As such, the demand for interventions that increase cognitive longevity in parallel with lifespan is high. Several studies have reported that caloric-restriction (CR) or fasting increase lifespan and improve cognition in humans and models of aging, but others have reported no beneficial effect of CR on cognition. These discrepancies may be explained by uncontrolled environmental factors inherent in large human studies, and the lack of genetic diversity in previous animal studies where effects of CR or fasting on cognitive longevity studies in one inbred strain of mice may not generalize to other mouse strains, let alone to humans. In this study, we compare the effects of Ad Lib, 1 day fast, 2 day fast, 20% CR and 40% CR on Y-maze working memory and contextual fear memory (CFM) in a genetically diverse population of mice - the Diversity Outbred (DO). We observed no benefit of CR or fasting on working memory or CFM at 24 months, despite expected increase in %live mice at 24 months. Actually, the 40% CR group exhibited impaired long-term CFM compared to groups fasted for 1 and 2 days. These results emphasize the importance of identifying therapeutics to enhance cognitive longevity, as CR enhancement of lifespan may not generalize to cognitive abilities.

1030. Rapid Local Anesthetic Warmer

Submission Category: Biomedical Sciences

Author(s):
- Benjamin Chasse
- Joshua Hamilton
- Nathan St. Jean
- Omar Alsamsam

Faculty Mentor: Michael Mason

Abstract:
The quality of patient care is obstructed by the pain post-injection of local anesthetics. Healthcare providers have attempted to resolve this issue by mixing the anesthetics with sodium bicarbonate, but it has been shown through clinical research that injection discomfort can be further reduced by warming the liquid to approximately 103 °F. The purpose of this work is to address the need for a rapid local anesthetic warmer so that healthcare providers may further decrease patient discomfort. To do this, we have developed plans for the construction of a rapid local anesthetic warmer, and plan to validate its function with three primary experiments. The first experiment's purpose is to demonstrate the precision and accuracy of temperature control within the anesthetic vial to reach 103 °F, which will be done by generating a calibration curve and comparing the internal and external temperatures of the vial during heating and cooling. The second experiment will assess the container's thermal stability by studying the deformation of the 3D printed filament. The final experiment will demonstrate the reliability of the system controlled by pre-programmed user inputs. Preset heating cycles will be programmed into the microcontroller of the system, and their accuracy in reaching the desired temperature of 103 °F will be assessed. The results of these tests will provide evidence of its efficacy as a rapid local anesthetic warmer for applications in a healthcare setting to reduce discomfort in patients and improve quality of care.

1031. The Crichton Mouse: A New Model for ADHD Derived From ENU-Mutagenesis Screen

Submission Category: Biomedical Sciences

Author(s):
- Michayla Moore
- Yehya Barakat

- Vivek Kumar

Faculty Mentor: Vivek Kumar

Abstract:
Animal models studied within the field of neuropsychiatric research have led to significant advancements in understanding the pathological changes driving many behavioral disorders and has been crucial in the development of new treatments. Despite the high heritability and growing prevalence of Attention-Deficit/Hyperactivity disorder (ADHD), gaps remain in the biological pathways underlying ADHD and the current availability of relevant pre-clinical models are lacking [1, 2]. A polygenic mouse model was developed in our lab through a N -ethyl- N -nitrosourea (ENU) mutagenesis screen selected for hyperactivity that develops in an age-dependent manner and is a mirrored clinical phenotype seen in patients diagnosed with ADHD [3, 4]. This mouse model, newly identified as the Crichton model, develops increased hyperactivity in the Open Field assay measured by total distance traveled and peaks at ~28 weeks of age. Key features identified in clinical studies of ADHD include dysregulation of specific brain regions such as the pre-frontal cortex, cerebellum, and striatum [5]. With this, we investigated neuronal changes within these three regions of Crichton brains compared to wild-type using immunohistochemistry as well as performed RNA-seq to assess transcriptional differences. Together, we found significant neuronal loss in the pre-frontal cortex of the Crichton mice compared to wild-type confirmed by anti-NeuN staining and significant transcriptional differences within these regions identified by RNA-seq. We did not see significant differences in either assay within the cerebellum or striatal regions. These findings provide additional evidence for pathological changes leading to hyperactivity phenotypes as well as introduces the Crichton mouse line as a new model to study the distinct molecular mechanisms involved in ADHD.

1032. Understanding the Role of Prophage Encoded Polymorphic Toxins in Mycobacterial Superinfection Immunity and Drug Resistance

Submission Category: Biomedical Sciences

Author(s):
- Dakota Archambault
- Jaycee Cushman
- Maddie Kimble
- Sarah McCallister
- JC Ross
- Colin Welch

Faculty Mentor: Sally Molloy

Abstract:
Mycobacterium abscessus is the leading cause of lung infection in cystic fibrosis patients and is often resistant to all antibiotics. There is an urgent need for alternative therapies such as lytic bacteriophage (viruses that infect bacteria). Phage therapy has been successful in the treatment of a drug-resistant M. abscessus infection in a teenaged cystic fibrosis patient but there are challenges to broad use as most M. abscessus isolates are highly resistant to lytic bacteriophage infection. Prophage, or integrated bacteriophage genomes within the M. abscessus genome, likely defend against phage superinfection via prophage-encoded viral defense systems. The Molloy lab has shown that the Mab cluster R prophage McProf increases bacterial resistance to both bacteriophage superinfection and antibiotics. To better understand the role of cluster R prophage in antibiotic resistance and superinfection immunity, we identified and characterized 25 novel cluster R genomes in sequenced clinical M. abscessus isolates. These strains encod a type VII secreted polymorphic toxin (PT) system that we hypothesize play a role in drug resistance and superinfection immunity. The PT cassettes include a small ESXA-like protein, a large PT with a WXG100 motif and a cognate immunity protein. There are two types of PT systems represented in the cluster R genomes: a Tde1-like DNAse and a second PT with no recognizable toxin motif. To determine the role of PT in superinfection immunity and drug resistance, I will construct an expression plasmid that encodes the second PT and test its effect on superinfection immunity and drug resistance in pathogenic mycobacteria.

1033. Progression of Cardiomyogenesis from Embryonic Stem Cells in a Three-Dimensional Gel Matrix

Submission Category: Biomedical Sciences

Author(s):
- Jonathan Bomar
- Dr. Scott Collins
- Dr. Rosemary Smith

Faculty Mentor:
- Scott Collins
- Rosemary Smith

Abstract:
Cardiovascular disease (CVD) accounts for about one in three deaths in the United States. Traditional therapies aim to minimize damage caused by CVD, but do little to address the loss of

healthy heart tissue following acute injury. Engineered cardiac tissue has emerged as a promising therapy for cardiac tissue repair. In this project, HM1 mouse embryonic stem cells suspended in a three-dimensional gel matrix are differentiated in vitro into functional cardiac tissue with a highly reproducible, complex spatial cooperation of multiple cardiac cell types. Starting at approximately day 3 of differentiation, fibroblasts grow outside the gel matrix, on the adjacent supporting glass substrate, and rapidly proliferate away from the gel matrix periphery. At approximately day 10.5, a spontaneously contracting network of myosin heavy chain (MHC)-positive cardiomyocytes self-organizes with the fibroblasts near the gel matrix periphery. We hypothesize that boundary cues and cell-cell interactions inside the gel initiate the outgrowth of fibroblasts, which in turn signal cardiomyocyte precursors to follow and further differentiate. Short term research aims are to map the spatiotemporal development of cell types in the tissue, identifying self-organization cues induced by boundary conditions. Long term goals are to apply these mechanisms to control in vitro cardiomyogenesis to engineer cardiac tissue for in vitro drug testing and in vivo cardiac tissue grafts.

1034. Analyzing and Characterizing the Strictly Lytic Infection of BPsΔ33 in Mycobacterium chelonae

Submission Category: Biomedical Sciences

Author(s):
- Matthew Cox
- Jaycee Cushman
- Sarah McCallister
- Emma Freeman
- Maddie Kimble
- Colin Welch

Faculty Mentor: Sally Molloy

Abstract:
Mycobacterium abscessus is a major causative agent of soft tissue and lung infection, especially in cystic fibrosis patients, and are oftentimes multi-drug resistant. Prophage, bacteriophage integrated into the host genome, play a role in antibiotic resistance in many pathogens, but the mechanisms by which this occurs are still unknown. Understanding the mechanisms of multidrug resistance will aid in the development of new treatments, such as improved drug regimens and/or phage therapy. The Molloy Lab recently demonstrated that two co-habitating prophage, McProf and BPs, increase antibiotic resistance and expression of antibiotic resistance genes relative to strains that carry only one or no prophage. We hypothesize that induction of the BPs prophage

and lytic gene expression activates genes in the second prophage that leads to changes in downstream gene expression and antibiotic resistance. To better understand how BPs lytic gene expression interacts with the second prophage, we aim to determine the temporal lytic gene expression profile of a strictly lytic mutant of BPS (BPsΔ33) during early, intermediate, and late phases of lytic infection of M. chelonae.

1035. Using Telomerase Reverse Transcriptase to Study Brain Neurogenesis at Different Stages of Adulthood

Submission Category: Biomedical Sciences

Author(s):
- Joshua Passarelli
- Gabriel Jensen

Faculty Mentor: Kristy Townsend

Abstract:
Researchers identify adult neural stem cells by their capacity to self-renew, differentiate into mature neurons and glial cells, and maintain an immature state over a long duration. However, there has been a lack of a specific and unique marker of quiescent adult stem cells in the brain, forcing investigators to rely on nonspecific stem cell markers, label-retention/lineage tracing studies, and proliferation markers to identify these cells. These methods led to non-specific labeling of stem cells in the adult brain. Mouse Telomerase Reverse Transcriptase (mTERT) is the rate limiting component of the telomerase holoenzyme complex in mice that is required for stem cells to avoid senescence, and has been shown to mark adult stem cells in other adult tissues, but we are the first to describe TERT as a marker of quiescent, slowly cycling adult brain stem cells. Using a direct reporter mouse line, we have mapped mTERT-expressing cells to novel, as well as well-described stem cell niches in the brain. Additionally, by comparing mTERT+ cells in young-adult to aged mice, we have been able to visualize and quantify these cells across the lifespan of the mouse. Finally, we performed co-immunostaining to identify the cell types that express mTERT within the adult mouse brain and have identified several markers that co-express with TERT. The data here support the use of mTERT as a much-needed unique and specific cellular marker to identify adult stem cells in the brain for the study of adult neurogenesis.

1036. Development of Image Collection Apparatus for Color Band Analysis

Submission Category: Biomedical Sciences

Author(s):
- Theo Erikson
- Alia Parsons
- Oisin Biswas
- Raymond Perry
- Caitlin Howell

Faculty Mentor: Caitlin Howell

Abstract:
With the spread of the SARS-CoV-2 virus, attention to the rapid assessment of surface cleanliness has intensified. Current monitoring methods of surfaces are both lengthy and expensive; however, nanostructured materials have recently garnered interest in quickly assessing the state of a surface. Structural color, or the bands of color that appear as different wavelengths of light reflected off a textured surface varies as a surface becomes contaminated with dust, dirt, or oil. To quantitatively analyze this phenomenon, a tri-axially rotating apparatus was constructed to dynamically measure the change in the structural color of samples that were either clean or contaminated. This apparatus, also known as TARDIS (Tri-axial Apparatus for the Rotation of Discrete and Independent Samples) is made of mostly 3D printed parts. It uses a phone camera to capture images and an Arduino to run three stepper motors to manipulate each of the three axes. The nanostructured material sample rotates on a platform exactly at the height of each arm's center of rotation. Both the camera and LED are centered about the sample and rotate with a set radius around said sample. This permits the generation of the hundreds of thousands of images at different angles required to analyze the structural color reflected off nanostructured material in an effort to detect the degree of contamination. The use of nanostructured surfaces and light to detect contamination has the potential to help slow the spread of the SARS-CoV-2 virus and other infectious materials via commonly used surfaces by providing a low-cost, timely detection method of surface contamination.

1037. Developing New Skills and Approaches to Authentic Research Experiences During COVID-19

Submission Category: Biomedical Sciences

Author(s): Jacob Cote

Faculty Mentor: Sally Molloy

Abstract:
Providing authentic student research experiences during COVID-19 presents a challenge for mentors and their learners in both the classroom and the research lab. The year-long UMaine SEA-PHAGES course typically supports 60 students in the isolation and characterization of novel bacteriophages, viruses that infect bacteria, using wet bench and bioinformatic approaches. The effects of COVID-19 on student safety inspired a novel research component for the 2020/2021 UMaine SEA-PHAGES cohort that could be conducted safely in the remote classroom. This year, students identified and characterized prophages, integrated viral genomes, in clinical strains of the drug-resistant pathogen Mycobacterium abscessus. For my CUGR summer research project in the Molloy lab, we collaborated with the Hatfull laboratory to develop new methods of prophage genome extraction for the new SEA-PHAGES research component. The outcomes of this research were the successful adaptation of the research component to the UMaine SEA PHAGES class and the development of my independent research project, characterizing a novel group of M. abscessus prophages that belong to the Mab cluster R. The Molloy lab has demonstrated that the presence of prophages, or bacteriophage genomes integrated into bacterial genomes, increases antibiotic resistance in pathogenic mycobacteria. Recent studies in our lab have shown that prophage-prophage interactions may be a novel mechanism of antibiotic resistance. Understanding the role prophages play in this resistance hinges upon deepening our understanding of the prophage communities in clinical bacterial isolates.

1038. An Aelic Series of Spontaneous Mutations in Rorb Causes a Gait Phenotype, Retinal Abnormality, and Gene Expression Changes Relevant to Epilepsy, Bipolar and Autism Spectrum Disorders.

Submission Category: Biomedical Sciences

Author(s):
- George Murray
- Robert W. Burgess
- Abigail Tadenev

Faculty Mentor: Abigail Tadenev

Abstract:
Mutations in RAR-related orphan receptor b (Rorb) cause a characteristic “high-stepper” phenotype in mice arising from dysfunction of interneurons in laminae III, V, and VI of the

dorsal horn of the spinal cord. Loss of rods and changes in cone photoreceptor abundance in the retina have also been reported in mice carrying Rorb null alleles. More recently, a critical role for Rorb in the formation of cortical barrels of the somatosensory cortex and thalamocortical afferent (TCA) projections was described. There are several clinical reports of RORB variants segregating with epilepsy, often with comorbid conditions such as intellectual disability and affective disorders. Here we describe five spontaneous mutations in Rorb identified at The Jackson Laboratory due to the overt gait phenotype that they cause in mice. These mutations affect different domains and splice variants of Rorb, which may explain the spectrum of anatomical and physiological abnormalities in these mice. Gene expression analysis in the most severely affected mutants implicates pathways associated with development and nervous system function and indicates decreased expression of genes involved in molecular circuits whose components are strongly associated with epilepsy, bipolar and autism spectrum disorders (ASD). These findings support the role of Rorb in nervous system development, provide further evidence for an association between RORB and epilepsy, and describe a group of Rorb mutant mice that might be useful to researchers interested in cortical development and animal models of transcriptomic shifts related to those occurring in neurological conditions such as epilepsy, bipolar disorder, and ASD.

1039. Red Raspberry Consumption Counteracts Pathological Conversion of Perivascular Adipose Tissue in Rat Model of Metabolic Syndrome.

Submission Category: Biomedical Sciences

Author(s):
- Marissa McGilvrey
- Natalie VandenAkker
- Kimberly Malka
- Penny Clum
- Lucy Liaw
- Stefano Vendrame
- Dorothy Klimis-Zacas

Faculty Mentor: Dorothy Klimis-Zacas

Abstract:
Metabolic syndrome (MetS) is a collection of physiological and metabolic abnormalities that increase risk of obesity, type-2 diabetes and cardiovascular disease (CVD). In these pathologies, systemic inflammation initiates a signaling cascade between the vasculature, adipose tissue, liver, and other organs. The local vascular environment is heavily influenced by perivascular

adipose tissue (PVAT) by secreting metabolically active molecules to either support vasorelaxation or promote pathological pro-contractile vascular activity, which plays a critical role in progression of CVD. As an alternative to traditional pharmacotherapy strategies to reduce inflammation, diets enriched in bioactive-rich plant foods, like raspberries and blueberries, are increasingly being used to prevent or reverse development of MetS and related pathologies. To study red raspberry (RR) enriched diets in MetS, male obese Zucker rats (OZR) containing homozygous leptin receptor mutation, and their lean littermates (LZR) were placed on a control (C) or 8% w/w RR-enriched diet for 8 weeks. Results published by VandenAkker et al documented that RR-enriched diet restores impaired vascular tone of OZR by enhancing vasoconstriction and attenuating vasorelaxation through eNOS and COX-2 pathways; and dramatic improvement of hepatic lipid deposition in OZR on RR diet. This study builds on these previous findings by evaluating the associated thoracic PVAT of these animals. Molecular evaluation of PVAT shows obesity induced increases in eNOS, as well as markers of signaling, inflammation, and adipocyte proliferation, are attenuated by RR-enriched diet. These results indicate that RR-enriched diets may play an important role in modifying PVAT to influence progression of CVD in metabolic syndrome.

1040. Characterizing neuropathy phenotypes and gene expression changes caused by peripheral myelin protein 22 overexpression in mouse models of Charcot-Marie-Tooth Disease 1A

Submission Category: Biomedical Sciences

Author(s):
- Audrie Langlais
- George C. Murray
- Timothy Hines
- Abby Tadenev
- Kathy Miers
- Courtney Hatton

Faculty Mentor: Robert Burgess

Abstract:
Charcot-Marie-Tooth Disease (CMT) is a heterogeneous group of inherited peripheral neuropathies affecting approximately 1 in 2,500 individuals. CMT1A, which comprises 30% of all CMT cases, is caused by a duplication in human chromosome 17 containing peripheral myelin protein 22 (PMP22). Patients with CMT1A experience a demyelinating neuropathy characterized by distal muscle weakness and reduced fine motor coordination and

proprioception. PMP22 is expressed by myelinating Schwann cells, where its overexpression impairs axon myelination and causes regulatory changes in the EGR2/SOX10 coexpression gene network. Our lab is investigating points of therapeutic intervention within this network that may modify neuropathy using validated transgenic mouse models of CMT1A including C22-PMP22 mice, with high expression of PMP2, and C3-PMP22 mice with lower PMP22 expression, albeit higher compared to wild-type. In this study, we investigated pathological phenotypes and transcriptomic changes associated with myelin and the integrated stress response using electrophysiology, histology and a published RNA-seq data set (Zhao et al, 2018). We observe visible myelin thinning and abnormal nerve conduction in C3-PMP22 mice. Differential expression analysis in C22-PMP22 spinal cord indicates time-dependent differential expression of SOX10/EGR2 targets and other myelination related genes as well as gene sets associated with cellular stress. These findings provide a basis to understand the molecular changes underpinning PMP22 neuropathy, identify potential points of therapeutic intervention, and will enable us to interrogate future RNA sequencing data from C3-PMP22 mice and human GWAS data in a hypothesis driven manner.

1041. Impact of Exercise on Dystrophic Skeletal Muscle

Submission Category: Biomedical Sciences

Author(s):
- Amanda Ignacz
- Elisabeth Kilroy
- Ahmed Almaghasilah
- Kodey Silknitter

Faculty Mentor: Clarissa Henry

Abstract:
Duchenne muscular dystrophy (DMD) is a fatal, progressive muscle-wasting disease that affects 1 in 5000 live male births. DMD is caused by mutations, usually deletions, in the gene coding for dystrophin production. Dystrophin acts as a link between the actin cytoskeleton and the extracellular matrix in myocytes. With a lack of functional dystrophin, as observed in DMD patients, muscle becomes more susceptible to damage as the cells contract and relax resulting in muscle degeneration and weakness. In a zebrafish model for this disease (sapje) it has been shown that the dystrophic phenotype can be ameliorated through endurance neuromuscular electrical stimulation (eNMES), providing insight on the effect of exercise on muscle structure and function. In DMD, slow-twitch muscle fibers tend to be more refractory to damage than fast-twitch muscle fibers. The first step in this analysis was assessing if there was a correlation

between fast-twitch and slow-twitch muscle fibers per myotome. From this any difference in fiber correlation between eNMES-treated and untreated fish could be determined. This will allow us to deduce whether eNMES plays a role in muscle fiber improvement or degeneration, and if the effect is seen in fast fibers, slow fibers, or both. Through quantitative scoring of myotomes, it was determined that eNMES-treated fast and slow muscle improvement/degeneration correlated less than that in the untreated muscles. This implies that eNMES impacts fast and slow fibers differently, and whether this is due to improvement or degeneration in one fiber type will be assessed in future analysis.

1042. Interferon Response Genes Expressed During the Innate Immune Response to Influenza A Virus

Submission Category: Biomedical Sciences

Author(s):
- Haley Foreman
- Julianna Grampone
- Riley Grindle
- Sarah Foust
- Brandy-Lee Sous
- Benjamin King

Faculty Mentor: Benjamin King

Abstract:
The Influenza A virus (IAV) is one of four types of Influenza viruses and is the predominant cause of flu pandemics. Changes in the viral genome through antigenic drift and shift continue to pose a significant threat to global health. The objective of our study is to understand innate immune response to IAV by comparing differentially expressed interferon response genes using a larval zebrafish model of IAV infection. Zebrafish larvae are an excellent model for the innate immune system as it is functional by 24-48 hours post fertilization and the adaptive immune system does not develop until 2-4 weeks later. The innate immune response to virus infection includes the interferon pathway. Interferons are proteins secreted by an infected cell that signal to nearby cells to resist further infection. Interferons can induce the expression of interferon response genes (IRGs). The corresponding protein products of these IRGs are responsible for mediating the antiviral response. We analyzed the set of 1,096 genes differentially expressed at 6 hours post IAV infection that were characterized using RNA sequencing. We compared these genes to homologous human interferon responses genes expressed from the Interferome database (http://www.interferome.org) to determine candidate IRGs. We used homology mappings

between zebrafish and human genes provided by Ensembl (https://www.ensembl.org). 74 candidate IRGs were found to be up-regulated, and 97 IRGs were found to be down-regulated. Future directions of our research includes validating the expression of the candidate IRGs by quantitative PCR. These studies will expand our knowledge of interferon signaling following IAV infection.

1043. Integrating Molecular Profiles with Clinical Outcomes in Cancer Patients from Rural Maine

Submission Category: Biomedical Sciences

Author(s):
- Michael Babcock
- Marek Skacel
- Benjamin King

Faculty Mentor: Benjamin King

Abstract:
Background: Current clinical pathology information systems are not well-structured to incorporate high-throughput genomic data. In addition, patient electronic medical records (EMRs) are ill-equipped for the integration of molecular profiling data forcing clinicians to rely on "paper documents" to support patient management. Furthermore, low resource, rural health care facilities do not have the budget for expensive storage systems, third party software, and/or specialized expertise. However, pathology laboratory information management systems (LIMS) can be queried and results collated with molecular profiles obtained from cancer patient tumors integrated into a separate relational database to support clinical data management.

Methodology This pilot study demonstrates how genomic data can be integrated with discrete synoptic pathology reports from a pathology LIMS and EMRs to read, extract, and analyze data. Using the RODBC package, an R script was developed to extract discrete pathology results from an anatomic pathology database (Sunquest PowerPath®). Data was then collated with patient genomic data obtained from a separate novel relational molecular pathology database using SQL. Data analytics can be performed for compliance with the College of American Pathologists (CAP) requirements.

Outcomes Results of clinical and overall molecular characteristics of cancer patients from rural Maine can be compared to those reported in the literature. In the future we would like to

incorporate genomic data with clinical findings obtained from both the patient EMR and pathology LIMS to support clinical decision making.

1044. The Effects of BTS Induced Inactivity on a Zebrafish Model of Duchenne Muscular Dystrophy

Submission Category: Biomedical Sciences

Author(s): Sean Driscoll

Faculty Mentor: Clarissa Henry

Abstract:
Duchenne's Muscular dystrophy (DMD) is a congenital disease of the muscle characterized by muscle atrophy, weakness, and a lower quality of life. Often diagnosed in children, it affects about 1 in every 5,500-7,700 males. A patient diagnosed with DMD is often told to avoid physical activities outside the required amount needed to go on with their day in order to preserve the muscle fibers and integrity. Inactivity in a healthy person leads to decreased muscle mass and increased weakening of the muscle, so the effects may be exacerbated in a person diagnosed with DMD having already weakened muscle. In this project, we explored the effects of inactivity on a zebrafish model of DMD. We used N-Benzyl-p-toluenesulfonamide (BTS), a myosin heavy chain inhibitor, to induce total inactivity for 72 hours consecutively at disease onset (2 days post fertilization), followed by a 72 hour recovery period out of BTS where normal activity is resumed. We then analyzed the effects on muscle structure (via birefringence and immunohistochemistry staining) and function (via swimming distance and velocity). We found that while muscle structure and function is improved immediately following the period of inactivity, upon resumption of normal activity, muscle structure and function was drastically reduced. This data can be used to help inform patients diagnosed with DMD, and potentially other forms of muscle disease, about the potential hazards of inactivity on the muscle structure and function.

1045. Nociceptive Sensitization in Larval and Adult Drosophila

Submission Category: Biomedical Sciences

Author(s):

- Christine Hale
- Samia Pratt

- Julie Moulton
- Geoffrey Ganter

Faculty Mentor: Geoffrey Ganter

Abstract:
Nociceptive sensitization underlies and perpetuates chronic pain, a condition that affects ~50 million adults nationwide. With many treatment options for chronic pain, such as opioid analgesics, carrying numerous deleterious side effects, research into safer and more effective treatment options is crucial. Recently, a nociceptive sensitization model was developed using Drosophila melanogaster larvae, in which UV-injured or genetically modified animals become hyper or hypo-sensitive. Using this model, the necessity and sufficiency of a novel pathway, the Bone Morphogenetic Protein (BMP) pathway, functioning in the nociceptors, was revealed. We have continued to build upon this knowledge to reveal a more complete mechanism for how nociceptive sensitization occurs by investigating into the potential roles of other novel genes/signaling pathways including, arm, a component within the Wnt/Wg signaling pathway. At present, our findings indicate Arm to be a facilitator in controlling nociceptor sensitivity. In addition to our focus on mechanisms that promote hypersensitivity, we also propose to expand our efforts by bringing new focus to more chronic nociceptor sensitization conditions. To facilitate these efforts, because the larval stages of fruit fly development are relatively brief, we are also developing a methodology that allows longer term experimentation of nociceptive sensitization after injury in adult fruit flies. Recent efforts toward this goal include mapping the adult fruit fly nociceptor distribution by confocal microscopy and developing thermonociception methods for use with adult flies. Our ultimate aim is to better understand the mechanisms of nociceptive sensitization so that better treatment options for chronic pain may be revealed.

1046. The Role of Cholinergic Interneurons in Impaired Cognitive Flexibility in Chronic Pain

Submission Category: Biomedical Sciences

Author(s):
- Megan Tomasch
- Makaela Rice

Faculty Mentor: Christoph Straub

Abstract:
Pain is a multidimensional experience with sensory-descriptive, motivational-affective, and evaluative-cognitive components. The impairments in cognitive functions associated with chronic pain contribute to the diseases disabling impact, but, despite their clinical importance, the mechanisms underlying these non-sensory aspects remain largely unexplored. One major cognitive impairment associated with chronic pain is decreased cognitive flexibility, i.e., an impaired ability to update the decision-making process in response to changes in the environment. Chronic pain is marked by structural and functional changes in prefrontal cortex (PFC) and nucleus accumbens (NAc), brain areas that are also implicated in cognitive flexibility. Within striatal tissue (including NAc), levels of the neuromodulator acetylcholine (ACh) are inversely correlated with cognitive flexibility both in humans and animal models. I hypothesize that chronic pain alters PFC-NAc signaling to increase ACh levels in the NAc, thereby decreasing cognitive flexibility and contributing to impaired cognitive function. To test this hypothesis, we use an established mouse model of chronic, the spared nerve injury (SNI). In agreement with previously published work, we find that SNI mice display reduced cognitive flexibility when assessed in a T-maze assay, confirming the suitability of this model. Electrophysiological assessment of cholinergic interneurons (CINs, the sole source of ACh in NAc) revealed increased spontaneous activity levels, in agreement with my hypothesis. Ongoing work aims to mechanistically characterize the pain-induced CIN hyperactivity and assess NAc ACh levels in vivo. Future work intends to test the casual role of CINs through in vivo modification of CIN activity during the cognitive flexibility assessment.

1047. Localizing Neural Activity within Murine Subcutaneous White Adipose Tissue (scWAT)

Submission Category: Biomedical Sciences

Author(s):
- Lydia Caron
- Josh Passarelli
- Sarrah Marcotte
- Leonard Kass
- Kristy Townsend
- Magdalena Blaszkiewicz

Faculty Mentor: Len Kass

Abstract:
Peripheral neuropathy is a devastating disease marked by the progressive loss of distal nerve fiber density and function, and is a condition that can be caused by over 30 medical conditions, the most notably being diabetes. Diabetic peripheral neuropathy is a small fiber polyneuropathy that starts at the skin surface, and nerve endings progressively degenerate proximally to deeper tissue layers. This subsequently causes complex symptoms including: tingling, pain, hypoesthesia, and in some cases the need for limb amputation. Earlier detection and diagnosis may offer hope for better treatment and prevention, especially for diabetic neuropathy which may benefit from tighter regulation of glucose levels to mitigate the neuropathy. Neuright, Inc., a UMaine spin-out and biotech start-up in Maine, has developed a novel microneedle array device that can detect neural activity in skin and underlying tissues. This new technology allows us to compare nerve electrical recordings in healthy mice as compared to recordings in a diet-induced diabetic model, with the goal of obtaining a more sensitive and accurate diagnosis of neuropathy. The focus of this study was to determine if neural activity varied with different positions of the microneedle array on the mouse flank skin. The array was inserted at three different locations (zone 1-3) in the scWAT depot of 16 control animals and then repeated in 12 cohort mice assessed on a high fat diet for increasing weeks (and thus, with worsening diabetes and related neuropathy). “Spike trains,” or the consistent firing of action potentials at a constant rate over time, were observed, occurring most frequently at a needle depth of 2.0 mm, within zone 2, and with needle locations 2+ and 2-. These findings reveal differences in neural output in varying locations and depths of microarray placement in scWAT of mice. Acknowledgement: We thank Julia Towne for her help in constructing the microneedle array. NOTE: data herein are covered by a provisional patent and are private and confidential.

1048. Varying Rates of Nerve Spike Activity Recorded Within Mouse Subcutaneous White Adipose Tissue

Submission Category: Biomedical Sciences

Author(s):
- Sarrah Marcotte
- Josh Passarrelli
- Lydia Caron
- Leonard Kass
- Janice L. Pelletier
- Rosemary Smith
- Magdalena Błaszkiewicz
- Kristy Townsend

Faculty Mentor: Leonard Kass

Abstract:
Infections, diabetes, injury, and different toxins can lead to peripheral neuropathy, a condition of nerve die-back which currently lacks adequate treatment and prevention measures. This project focused on using a novel needle electrode array to detect nerve signals with peripheral neuropathy, for the purpose of eventually more sensitively diagnosing and treating neuropathy. In this study, needles in the array were connected to differential amplifiers that were able to record electrical activity from subcutaneous white adipose tissue (scWAT) when inserted into mouse skin. Some of the neural activity recorded were considered “spikes”, or putative action potentials. Some spikes, occurring at fairly regular intervals, are referred to as spike trains that vary between 5 and 20 spikes/sec. The rates of these spike trains tended to decrease over the time of the experimental recording duration, due perhaps to the effects of the anesthetics on the mouse nervous system during these hour-long recordings. Even though the rates of these spike trains differed somewhat from animal to animal, they were constant within an animal, even when the needle electrode array was inserted into different (though adjacent) regions of scWAT. Warming the mouse showed increases in the rate of the recorded spike train. We interpreted this finding as suggesting that the neural substrate that conducts the spike trains within scWAT extends over many millimeters of tissue in different directions. Acknowledgement: We thank Julia Towne for her help in constructing the microneedle array. NOTE: data herein are covered by a provision patent and are private and confidential.

1049. Characterizing The Diversity of Cluster R Prophage in Mycobacterium abscessus

Submission Category: Biomedical Sciences

Author(s):
- Colin Welch
- Maddie Kimble
- Dakota Archambault
- Claire Bourett
- Hector Orellana
- Andre Daigle

Faculty Mentor: Sally Molloy

Abstract:
The opportunistic pathogen Mycobacterium abscessus is one of the most resistant bacterium to antibiotics and maintains a low cure rate of 25%–58%. Investigating the mechanisms of

antibiotic resistance in M. abscessus may lead to more effective treatments. Prophage, viral genomes that are integrated into bacterial genomes, are known to enhance the virulence of many bacterial pathogens. Yet, their role in pathogenic mycobacteria virulence is not yet known. The Molloy lab determined that the prophage McProf increases resistance in pathogenic mycobacteria through the upregulation of the antibiotic resistance gene WhiB7. This upregulation was enhanced whenever there was a cohabiting prophage with McProf. To understand how prophage influence drug resistance in M. abscessus, we have identified and extracted eight novel McProf-like that form a novel Mab cluster R. We also identified six unique cohabiting prophage. We identified sixteen duplicates of the eight MabR prophage, each containing duplicates of at least one of the six cohabiting prophage. To understand the relationships between the MabR prophage and the cohabiting prophage, we analyzed the genome content of the prophage and the frequency and distribution of the MabR and cohabiting prophage within the M. abscessus isolates.

1050. Collagen Microscopy Image Analysis Using Second Harmonic Generation (SHG).

Submission Category: Biomedical Sciences

Author(s):
- Christopher Roberts
- Betelhem S. Abay
- Karissa Tilbury

Faculty Mentor: Karissa Tilbury

Abstract:
The tumor microenvironment is a complex hub of cellular and non-cellular signaling cascades that often are protumorigenic. Fibrillar collagen is the most abundant protein in the tumor microenvironment. Numerous studies have demonstrated the importance of collagen remodeling and have linked unique morphological signatures of collagen fibers to patient survival using a collagen-specific, label-free imaging technique called Second Harmonic Generation (SHG) microscopy. SHG is a non-linear process in which 2-photons are scattered from a non-centrosymmetric structure creating a single photon with half the wavelength and twice the frequency to conserve energy. The direction of SHG scattering, Forward or Backward, is dependent on phase matching. Here we employ both Forward and Backward SHG detection to probe collagen fiber remodeling in a 3D tumor microenvironment. Low density collagen gels (2 mg/mL) were seeded with both breast cancer (MCF7A and MDA-MB-231) and fibroblast cells (cAMP activated +/-) to recapitulate the interaction of breast cancer cells and neighboring normal fibroblasts. The 3D tumor models were fixed with PFA after 72 hours for both Forward

and Backward SHG, and 2p fluorescent cell-specific imaging studies. A custom image analysis algorithm is currently under development using Ilastik to segment cells to use for a localized assessment of collagen remodeling around the cells. Analysis is still underway; however preliminary results are supportive of the hypothesis that activated fibroblasts are more impactful in remodeling the tumor microenvironment and may be more influential in the protumorigenic tumor microenvironment than the aggressiveness of the tumor cells themselves. Further development and refinement of this model and analysis pipeline is important in understanding the biophysical interactions of collagen remodeling in tumor microenvironments.

1051. Characteristics of Neural Electrical Activity Recorded Beneath the Skin in Diabetic Mice

Submission Category: Biomedical Sciences

Author(s):
- Joshua Passarelli
- Lydia Caron
- Sarrah Marcotte
- Leonard Kass
- Magdalena Blaszkiewicz
- Janice Pelletier

Faculty Mentor: Kristy Townsend

Abstract:
Peripheral neuropathy (PN) affects over 20 million Americans, with diabetic peripheral neuropathy (DPN) being the largest subcategory. PN is characterized by the progressive loss of innervation from distal to proximal tissues of the peripheral nervous system. Although there is no cure for PN, early detection may allow treatments to help slow disease progression, especially in DPN where glucose regulation may be important to mitigate the neuropathy once detected. Unfortunately, current tools used for a functional diagnosis of PN tend to detect denervation of larger nerves, which occurs late in disease progression. There is not currently a medical device for the diagnosis of small fiber neuropathy using nerve function. Here, we have developed a device to measure the electrical activity of nerves beneath the skin, which are the first to be affected by DPN. We hypothesize that early detection of DPN can be achieved by identifying a loss or change in the activity of these more distal small fiber nerves. Pre-clinical proof-of-concept studies in mouse models of diet-induced diabetic neuropathy revealed multiple characteristics of neural activity that may be a signature of DPN onset. Neural activity recorded from animal models using our methods were categorized into 3 types: (1) “spike trains”, or

evenly-spaced sequences of spikes (which are putative action potentials, or APs); (2) “spike bursts,” or APs occurring periodically; and (3) “individual spikes,” which occur in a singular fashion. Electrophysiological results obtained in murine models with this device favor the potential utility of this product for the early detection of DPN in humans. Such a product could provide early diagnosis that may help prevent the progression of PN for millions of affected individuals and improve prognosis. Acknowledgement: We thank Julia Towne for her help in constructing the microneedle array. NOTE: data herein are covered by a provision patent and are private and confidential.

1052. Infection and Diet-induced Gut Dysbiosis: Impact on Sleep Fragmentation in Danio Rerio

Submission Category: Biomedical Sciences

Author(s): Ben Williams

Faculty Mentor: Robert Wheeler

Abstract:
A known bidirectional relationship between intestinal microflora and the central nervous system, coined the gut-brain-axis, has provoked researchers to examine the correlation between gut dysbiosis, inflammation, and sleep quality. Previous studies within the Hayes Lab have reported that a high fat (HF) diet yielded an association with the mean number of immobile phases and sleep duration. These findings are concordant with previous studies which report that Western Diet is associated with activation of a gut dysbiosis-induced acute phase response (Zinöcker and Lindseth, 2018), which is known to alter clock gene transcription and upregulate NREM sleep (Cavadini et al, 2007). Within this Honors Thesis, an existing protocol for Danio rerio sleep analysis (Sorribes et al., 2013) was modified in order to, for the first time, assess the correlation between inflammatory pathways, induced via direct infection by the human fungal pathogen Candida or via a HF diet-induced gut dysbiosis mechanism, and sleep quality. Preliminary results indicate that there is high variability in zebrafish sleep analysis but that 3/4 of infected zebrafish larvae (n = 42) cohorts yielded a greater total sleep duration than the respective control groups (n = 42), as well as a greater mean sleep bout length, and a smaller fragmentation index. Despite these findings, preliminary qPCR analyses do not support a correlation between inflammatory gene expression (e.g. TNF-α, IL-1β, or IL-6) and differential sleep quality. Further research will include repetition of the infected cohort analysis as well as identical experimental methods administered to the HF diet cohort.

1053. 3D Tracking of Muscle Precursor Cell Movement in Zebrafish

Submission Category: Biomedical Sciences

Author(s):
- Sabrina Varga
- Jared Talbot

Faculty Mentor: Jared Talbot

Abstract:
Cell migrations are vital to normal embryonic development, but when they go awry it can lead to disease. The cues that control cell migrations are not understood fully and can vary between different biological contexts. The Talbot lab conducts research on how muscle precursor cells migrate in zebrafish embryos. First, a timelapse is taken using a confocal microscope on the developing zebrafish. These images are collected in 3D by imaging a stack of XY slices, and new image stacks are collected every two to three minutes. The data is then put into an artificial intelligence driven program, Aivia, for 3D cell tracking. Traditional cell tracking programs, without artificial intelligence, use nuclear labels to track the cells and require extensive manual input; however, we lack nuclear labels for the cells in question. Instead, I "teach" the program how to identify cell centers by painting the appropriate areas of a subset of images and applying machine learning algorithms to find the rest. Once taught, the software can identify the center of cells based on their membrane labels and uses a custom-optimized algorithm to track those identified cell-centers like they were nuclei. Using this program, we will test how FDA-approved drugs influence cell movements in whole living organisms, thereby revealing precisely how these drugs influence cell behaviors.

1054. Epigenetic Effects of Dio3 Knock-Out Paternal Lineage on Fertility in Female Mice

Submission Category: Biomedical Sciences

Author(s): Logan Douglas

Faculty Mentor: Arturo Hernandez

Abstract:
This study concerns the transgenerational epigenetic effects of thyroid hormone. Its objective was originally to investigate the phenotype of CD-1 mice born from mothers heterozygous for an inactivating mutation of Dio3 gene, which codes for a protein that catalyzes the breakdown of

thyroid hormones. These mothers were born from either phenotypically normal heterozygous fathers or from Dio3KO fathers, which were overexposed to thyroid hormone during development. These two groups of females were crossed with wild type males and we aimed to analyze the offspring for growth and neuroendocrine molecular markers related to adipose tissue function and the leptin-hypothalamic system. Most mothers from the control lineage got promptly pregnant and a complete set of serum and RNA samples from hypothalamus and adipose tissues were isolated from their 2-weel old offspring. However, the KO paternal lineage mothers did not give birth to any pups after 3 months with the male. The project pivoted to investigate the fertility impairment of these females. Previous lab data has shown that these females exhibit increased adiposity, reduced bone mass and altered hypothalamic gene expression compared to control females. The phenotype difference despite their identical genotype and mode of inheritance suggests an epigenetic cause. Data from daily vaginal smears on available females over 16 days suggested a deficient estrous cycle, but this was not statistically significant. For future analyses of gonadal axis function, we used some females to collect serum and ovaries, which appeared cystic and swollen especially in those most obese.

1055. Loss of LOTR-1 Affects Germ Granule Movement in Germ Cells

Submission Category: Biomedical Sciences

Author(s): Madeleine Nowak

Faculty Mentor: Dustin Updike

Abstract:
Germ granules are ribonuclear proteins that localize to the cytoplasmic surface of germ cell nuclei. One constitutive component of germ granules, from nematodes to humans, is a protein that contains both LOTUS and Tudor domains. In mammals, these proteins (TDRD5 and TDRD7) are critical for spermatogenesis and are also associated with familial glaucoma and cataracts, yet their molecular functions are difficult to attain. The homolog in C. elegans, LOTR-1, can be visualized and manipulated in this genetic model to understand its role further. Immunoprecipitation of LOTR-1 followed by quantitative mass spectrometry revealed the potential for the LOTUS domains of LOTR-1 to interact with the cytoskeleton. A strain where germ granules are labeled with a red fluorescent protein (RFP) makes it easy to visualize germ granule dynamics. We sought to test whether cytoskeletal interactions through the LOTUS domain account for these dynamic germ granule movements. Using a spinning disc confocal, I imaged germ granules dynamics over time in four-cell embryos. Images were taken every 500 ms for two minutes. After creating videos, germ-granule movement was tracked using Imaris image analysis. The number of granules per embryo, mean granule track length, and mean

granule speed was collected and analyzed using t-tests in Excel. While the wild-type and LOTR-1 deletion strains did not differ in the average amount of germ granules per embryo, the mean track length for germ granules was shorter in mutants by a slightly significant margin. Surprisingly, the mean track speed of germ granules in the LOTR-1 mutant strain was also slightly faster. Overall, these results seem to indicate that germ granules in LOTR-1 mutant embryos interact more loosely with the cytoskeleton, which could cause both these shorter path lengths and higher mean track speeds.

1056. Study on the Synergistic Activity of Fluconazole and Cyclosporine A on Candida albicans

Submission Category: Biomedical Sciences

Author(s): Maria Vina Lopez

Faculty Mentor: Robert Wheeler

Abstract:
Candida albicans is an opportunistic pathogen that can cause mild yeast infections but is also able to get into the bloodstream and cause severe illness. It is life-threatening in immunocompromised individuals and we aim to improve the therapeutic options. Fluconazole is an antifungal azole drug that causes membrane stress and is commonly used to treat candidiasis. However, it is fungistatic--it inhibits the growth of Candida but does not kill it--and this encourages emerging drug resistance in C. albicans. We have observed a fungicidal synergy--killing of Candida--between fluconazole and cyclosporine A (CSA). CSA is an immunosuppressive drug that also exhibits antifungal activity by inhibiting calcineurin, a phosphatase, that contributes to fungal stress resistance. In this project, I will test how CSA works so we can understand how the two drugs synergize, with the ultimate goal of discovery of better treatments for Candida infections.

1057. Investigating the Interaction of Streptococcus Agalactiae and Candida albicans in Vitro and in Vivo

Submission Category: Biomedical Sciences

Author(s):

- Kathryn Patenaude
- Siham Hattab
- Robert T. Wheeler

- Melody N. Neely

Faculty Mentor: Melody N. Neely

Abstract:
Treatment of opportunistic infections can be problematic because we do not have a complete understanding of how factors or other organisms found in the localized environment play a role in the progression of infection. One factor that has been poorly studied is how bacteria and fungi interact together in the host, and how that may be influencing the progression or virulence of pathogens in an infection or even in causing co-infections. Both the fungus *Candida albicans* (Ca) and the bacteria *Streptococcus agalactiae* (Group B Strep or GBS) are commensals that reside in the vaginal tract. While usually harmless in the human host, both of these organisms can cause opportunistic infections in immunocompromised patients, which can also progress to co-infections. What we don't understand is how interactions between these organisms can affect the progression of infections caused by each pathogen or how they affect treatment outcomes. Previous in vitro work has sought to analyze synergistic and antagonistic interactions between other commensal bacteria and Ca, but there is not much known about how GBS and Ca interact in co-infections and what influence that interaction may have on the effectiveness of current treatments for each of the individual pathogens. Through both in vitro and in vivo experimental methods, we will investigate in depth the influence each have on each other in their individual growth, their virulence, and their resistance to treatment.

1058. Delayed Healing and Nav1.8 Nerve Regeneration Following Corneal Injury in Sox11 Conditional Knock-out Animals

Submission Category: Biomedical Sciences

Author(s):
- Cara Sullivan
- Jun Lee

Faculty Mentor: Ian Meng

Abstract:
Corneal nerve injuries are a common source of ocular pain and discomfort that can result from disease, injury and ocular surgeries. Delayed healing of the corneal epithelium and nerves can lead to extended pain and discomfort. This study investigated the role of the nerve regeneration-associated gene Sox11 in corneal wound healing and reinnervation following acute and chronic injury. Two injury models were used to create corneal nerve injury, double lacrimal

gland excision (LGE) which induces chronic dry eye by eliminating the aqueous component of tears and corneal abrasion (CA) which mechanically removes the corneal epithelium and axon terminals. LGE results in persistent corneal epithelial cell damage and retraction of corneal afferent nerve terminals, while the abraded axon terminals in CA are allowed to recover. Corneal fluorescein was used to examine the severity of epithelial damage, mechanical sensitivity was evaluated using a corneal aesthesiometer and nerve terminal density was imaged and Sholl analysis was performed. This study found that Sox11 knockout animals exhibited delayed epithelial healing following both acute and chronic injury. Post-injury mechanical hyposensitivity was observed across phenotypes and nerve regeneration was significantly reduced in Sox11 knockout animals. Expression of key regeneration factors, while normally shown to increase following corneal injury, was diminished following injury where Sox11 expression was knocked down. In summary, our results provide evidence of Sox11's intrinsic role in nerve development and the impact of its absence on nerve regeneration and epithelial healing.

1059. Uncovering Candida albicans Factors that Modulate the Host Phagocyte Response

Submission Category: Biomedical Sciences

Author(s):
- Bailey Blair
- Emma Bragdon

Faculty Mentor: Robert Wheeler

Abstract:
Opportunistic fungal infections caused by Candida and Aspergillus primarily affect immunocompromised patients, but they can be quite deadly in the hospitalized patient population. The ability of Candida albicans to evade the host immune system helps it to be a successful pathogen, but little is known about how C. albicans achieves this. Previous work in our lab suggests that the ability of C. albicans to switch to the hyphal growth form may help to limit the recruitment of phagocytes to the infection site, but the mechanism responsible for this is not yet understood. In order to further understand this, we are using the larval zebrafish hindbrain infection model to screen a large number C. albicans mutants for their virulence. This is the first screen of this scale to look at the virulence of individual C. albicans mutants in a live host. This identified a number of mutants that show a virulence defect, including many that have not previously been characterized for their virulence. Transgenic zebrafish with fluorescent immune cells are now being used to investigate the phagocyte response to hypovirulent mutants. This will allow us to identify important genes and pathways for limiting the host phagocyte

response, including immune cell recruitment and pathogen engulfment. Preliminary data with one hypovirulent mutant suggests that deletion of a single fungal cell wall protein enhances uptake by the host. This work will allow us to gain valuable insight into C. albicans factors that allow it to evade immune attack.

1060. Antimicrobial Agent Cetylpyridinium Chloride Interferes with Phosphatidylinositol 4,5-bisphosphate-protein Interactions in Influenza Infection Fibroblast Model and in Mast Cells.

Submission Category: Biomedical Sciences

Author(s):
- Prakash Raut
- Sasha Weller
- Bright Obeng
- Bailey West
- Christian Potts
- Julie Gosse

Faculty Mentor: Samuel T. Hess

Abstract:
As we endure through this pandemic, vaccines are very important to curb the pandemic and save millions of lives. In addition to the vaccines, other anti-viral therapeutics or drugs that can help to save lives become crucial moving forward. In order to find alternative such anti-viral therapeutics, it is crucial to understand the viral lifecycle and the interactions between viral proteins and the host cell. Influenza A virus (IAV) Hemagglutinin (HA) is a viral glycoprotein responsible for viral binding and entry. HA clusters at the plasma membrane of the host cell, and these clusters need to be high in density in order to catalyze membrane fusion for viral entry. However, the mechanism by which HA forms clusters remains unknown. We recently showed clustering of HA is modulated by phosphatidylinositol (4,5) bisphosphate (PIP2) [N.M. Curthoys et al. Biophysical Journal, 2019]. Targeting this interaction could lead to possible alternative anti-viral therapeutics. CPC (cetylpyridinium chloride) is a positively charged quaternary ammonium compound used in mouthwashes and personal care items. CPC has been previously shown to have antibacterial and antiviral properties. While both the antibacterial and antiviral properties are well understood at high concentrations (millimolar), the effect of CPC on cell function at relatively low (micromolar) concentrations is not well understood. In this study, we use the super resolution microscopy technique FPALM [S.T. Hess et al., Biophysical Journal, 2006] to study the effect of CPC on phosphatidylinositol (4,5) bisphosphate (PIP2) binding

proteins, and to illuminate the mechanism of the antiviral properties of CPC at the these much lower, non-cytotoxic micromolar concentrations in the cell model. Results show that CPC at these concentrations significantly modulates PIP2 clustering and HA clustering more importantly reducing the HA density and also significantly reduces their co-clustering. These results are important because dense HA clusters correlate with the efficient viral entry and infectivity and modulating PIP2 clusters reduces HA clustering. In addition, we also show CPC at mircomolar concentration can improve survival of zebrafish infected with IAV.

1061. Defective CXCR4 Signaling Decreases Survival in a Zebrafish Model of Influenza A Virus Infection

Submission Category: Biomedical Sciences

Author(s):
- Brandy Soos
- Con Sullivan
- Paul A. Millard
- Carol H. Kim
- Benjamin L. King

Faculty Mentor: Benjamin L. King

Abstract:
The World Health Organization has estimated that up to 650,000 deaths occur per year from respiratory diseases associated with seasonal influenza infections. Influenza A virus (IAV) causes severe disease in older adults and individuals with chronic health conditions. The long-term goal of our studies is to understand the molecular mechanisms of the innate immune response to IAV infection and find new antiviral therapeutic targets. Neutrophils have essential roles in innate immunity to bacterial and fungal infections, but their roles in antiviral responses are understudied. Recently, it was demonstrated that IAV infection can be established in zebrafish (Danio rerio) larvae. The zebrafish are powerful vertebrate models that have been used to study infection and innate immunity. We are using this model to study the roles of neutrophils in controlling IAV infection and how over-activation during IAV infection triggers a damaging hyperinflammatory response. First, we are examining pathways which regulate respiratory burst function and how reactive oxidative species control neutrophil function during IAV infection. 12 members of the CXCR4 signaling pathway were differentially expressed at 6 hours post-infection. Survival studies of IAV-infected WHIM (Tg1(-8mpx:cxcr4b-EGFP)) mutants that overexpressed a truncated cxcr4b transgene had decreased survival compared to sibling controls that underscore the roles of neutrophils. Second, we are investigating how hyperinflammation

occurs during IAV infection so therapeutic measures that preserve the antiviral response, yet contain the associated inflammation, can be developed. This work is supported by the National Institute of Allergy and Infectious Disease of the National Institutes of Health (R15AI131202).

1062. Optimizing RT-LAMP for use in Wastewater COVID Testing

Submission Category: Biomedical Sciences

Author(s):
- Audrie French
- Kettie Rose Cormier
- Harrison Cyr

Faculty Mentor: Robert Wheeler

Abstract:
RT-LAMP (reverse transcriptase loop-mediated isothermal amplification) is a simple, rapid detection method for the SARS-CoV-2 virus. Currently, most tests for the virus use RT-qPCR (reverse transcriptase quantitative PCR) – this includes both swab samples and wastewater RNA extracts. Both RT-qPCR and RT-LAMP amplify a target nucleic acid sequence for specific detection. RT-LAMP is far more adaptable to use on site at wastewater treatment plants or other non-lab testing facilities as it is done at a single temperature and it can be scored positive by eye based on a color change. However, using a thermocycler or a plate reader in conjunction with a fluorescent nucleic acid dye allows for more quantitative analysis of the sample. Using the qPCR machine yields real-time quantitative data on the samples, and the fluorescent dye may allow detection of positive results not detected by a visual color change, while still allowing the colorimetric results to be visually analyzed. Using a fluorescent dye post-protocol and viewing with a plate reader or using the dye with a qPCR machine may yield more sensitive results than the colorimetric LAMP itself.

1063. Neurological and Muscle Fiber Health in Zebrafish Dystrophy and Dystroglycanopathy Models

Submission Category: Biomedical Sciences

Author(s):
- Mary Astumian
- Prakash Raut

- Sam Hess
- Erin C. Bailey
- Clarissa Henry

Faculty Mentor: Clarissa Henry

Abstract:
Muscular dystrophies and dystroglycanopathies are progressive diseases, with varying severity, affecting neurological and muscle health. In functional muscle fibers, alpha-dystroglycan and integrin-alpha7 proteins attach the actin cytoskeleton to the extracellular matrix (ECM). To function, integrins must cluster in the muscle membrane and alpha-dystroglycan must be glycosylated. GMPPB and DPM3 genes are essential for glycosylation. GMPPB helps glycan production while DPM3 (Dolichyl Phosphate Mannosyltransferase Subunit3) stabilizes glycosylation. Both are mutated in human dystroglycanopathy subsets. Dystroglycan and integrin-alpha7 are receptors for the extracellular matrix laminin. Previous work revealed oxidized nicotinamide adenine dinucleotide (NAD+) treatment improved laminin deposition and muscle health in dystroglycan and integrin-alpha7 zebrafish mutants. NAD+ remains to be tested in DPM3 mutants but did not improve muscle health in GMPPB mutants. One hypothesis explaining these contrasting results is hypoglycosylated dystroglycan lacks sugar sidechains so cannot cluster, interfering with integrin-alpha7 clustering. The localization of dystroglycan and integrin-alpha7 proteins relative to each other at the muscle cell membrane is hypothesized to be important. Using superresolution microscopy, images of Dystroglycan, GMPPB, and DPM3 mutants treated and untreated with NAD+ will be analyzed to assess the average distance between the molecules of dystroglycan and integrin-alpha7 at the myofiber membranes. Neurological and muscle health will be measured with synapse staining, birefringence, swimming behavior, and cell adhesion.

1064. Genetically Regulated Expression and its Role in Oocyte Sensitivity to Chemotherapy in Diverse Mouse Strains.

Submission Category: Biomedical Sciences

Author(s):
- Rose Besen-McNally
- Zachary Boucher
- Ewelina Bolcun-Filas

Faculty Mentor: Ewelina Bolcun-Filas

Abstract:
Many drug treatments for cancer not only target the diseased cells but can also attack and damage other healthy tissues. This can lead to decreased fertility or infertility due to the chemotherapy drugs damaging oocytes in primordial follicles (PF). To understand how and why some women are more resistant to oocyte loss studying this genetic variation in mouse models can help us. Oocytes in C57BL/6J (B6) juvenile females are highly sensitive to chemotherapy drugs such as cisplatin and it is seen that following treatment they lose most of their PF. In comparison CAST/EiJ mice which begin with a smaller oocyte reserve, they maintain more PF following cisplatin treatment. Single cell RNA sequencing of ovaries in these two strains revealed lower expression of the xanthine dehydrogenase (XDH) gene in CAST than in B6 oocytes. XDH is known to play a role in oxidation and has been shown to potentiate cisplatin toxicity; therefore was identified as a potential candidate for increased sensitivity in B6 oocytes. Drugs inhibiting XDH are used for gout treatment and could be repurposed to protect oocytes. This study aims to identify if and then how XDH may be sensitizing oocytes to cisplatin. Identification of specific genes which make oocytes more or less vulnerable to damage by chemotherapy drugs could allow for the development of predictive markers and protective treatments to prevent or decrease the chances of full fertility loss.

1065. Yeast Actin Cytoskeleton Regulation by RGS

Submission Category: Biomedical Sciences

Author(s):
- Lucas Craig
- Cory Johnson
- Joshua Kelley

Faculty Mentor: Joshua Kelley

Abstract:
Yeast release pheromone into their environment to signal to nearby yeast that they can mate. The receptors for this pheromone are G-protein coupled receptors (GPCRs). Once these GPCRs detect this pheromone yeast cells grow towards the pheromone gradient to contact the possible mate and begin the mating process. GPCRs are found throughout the human body and are common targets for many drugs, so understanding how they are regulated is essential, particularly with the Regulator of G-protein Signaling (RGS) Sst2. This RGS has previously been shown to also interact with actin polymerizing proteins (formins) leading us to ask if Sst2 mutants affect polymerization of actin and how the regulation of these formins by Sst2 alters mating efficiency. Using actin staining with phalloidin and confocal microscopy we investigated

the localization of actin when Sst2 has been mutated at its activating phosphorylation site. Using mating assay techniques, we also investigated the impact on yeast mating. We find that actin, which is usually localized to the site of growth in yeast responding to pheromone, is poorly organized in yeast with mutated Sst2. We also find that yeast mating efficiency is decreased with mutated proteins. This indicates that Sst2 is important in regulating the localization of actin which is a key component in the cell cytoskeleton and is important in allowing the cell to continue to grow, therefore, decreasing mating efficiency. This allows us to better understand how GPCRs are regulated and how these regulators affect cell health.

1066. Regulation of Septins Through Receptor-epsin Interactions

Submission Category: Biomedical Sciences

Author(s):
- Sarah Latario
- Cory Johnson

Faculty Mentor: Joshua Kelley

Abstract:
Yeast utilize a G-protein coupled receptor (GPCR) signaling pathway for mating, that recognizes mating factor and leads to cell polarization and elongation. For directed polarization to occur, endocytosis of the mating receptor is needed to internalize regions of the cell's membrane where mating factor has bound. Epsins are proteins that support membrane curvature and assist in selective endocytosis. They also contain a domain that is known to interact with septin regulators. Therefore, we suspect that epsins are involved in coupling endocytosis to septin deposition. Septins are cytoskeletal components that provide membrane stability, restrict transmembrane protein diffusion, and require precise regulation for proper cell polarization. To test the role of epsins in septin distribution, we engineered yeast deletion strains that lacked epsins (ENT1 and ENT2), exposed them to pheromone using microfluidics devices and monitored them over 12 hours to track polarization and elongation. Additionally, we deleted ENT1 in a hyperactive Gα strain that manifests improper septin deposition and an inability to track a gradient, to further investigate our hypothesis. Our data suggests that Ent1 is partially involved in coupling endocytosis to septin deposition, that epsins may be involved in proper septin distribution, and that yeast lacking epsins may have an altered mating response.

1067. Analysis of Cluster MabD Prophage

Submission Category: Biomedical Sciences

Author(s):

- Andre Daigle
- Colin Welch

Faculty Mentor: Sally Molloy

Abstract:
Bacteriophages are viruses that infect bacteria and comprise an estimated 1031 particles in the biosphere. Prophage, viral genomes integrated into the bacterial genome, encode genes that often increase the fitness of the bacterial cell, including viral defense systems and toxin/antitoxin systems. Mycobacterium abscessus causes lung infections in patients with lung diseases such as cystic fibrosis and is often extensively drug-resistant. The relationship between the drug resistance of M. abcsessus and prophages is understudied. The Molloy lab established that cohabitating prophage alter drug resistance in pathogenic mycobacteria. The aim of this project is to characterize M. abscessus prophages that co-habitate with a second type of prophage (Mab Cluster R prophage) that is known to alter drug resistance in mycobacteria. Two Mab cluster D prophages were identified and extracted from clinical isolates of M. abscessus that carry cluster R prophage genomes. The prophiFLQ01-2 and prophiFSQJ01-3 genomes are 503226 and 50715 base pairs in length and encode for 79 and 85 genes respectively. MabD cluster genomes are highly conserved through the structural genes in the right arm. At the left attachment site, both prophages encode a tyrosine integrase gene. Near the integrase are a divergently transcribed immunity repressor and likely Cro gene, although the protein Phams differ between the two genomes. At the right attachment site, both prophages carry Type VII-secreted polymorphic toxin systems that include an ESAT-6 protein, a polymorphic toxin, and an immunity protein. This cassette is being studied further as genes that potentially increase the fitness of M. abcessus.

1068. Notch Signaling Regulates PVAT Function During Diet-induced Obesity

Submission Category: Biomedical Sciences

Author(s):

- Chenhao Yang
- Anne E. Harrington
- Larisa M. Ryzhova

Faculty Mentor: Lucy Liaw

Abstract:
Obesity is an established risk factor for cardiovascular diseases (CVD) and possibly shares molecular and cellular disease mechanisms as CVD. As a component of the vasculature, perivascular adipose tissue (PVAT) is as a critical regulator of vascular function due to its anatomical proximity to the vascular wall. In addition to a broad role in embryonic development, Notch/Rbp-jk signaling plays a crucial role in regulating metabolic homeostasis. Suppression of Notch signaling components was reported to induce beige phenotypes within white adipose tissue. We studied how Notch/Rbp-jk signaling and potential downstream pathways regulate PVAT phenotype. We generated mouse models with adipose tissue specific knockout of Rbpj genes or overexpression of Notch intracellular domain using Adipoq-Cre driver and examined their physiology, histology, and expression of metabolic and vascular relaxation pathway components as compared to control non-Cre mice. Our data showed that Notch signaling was activated in PVAT during high fat diet (HFD) treatment. Expression of Notch signaling component including RBPJ-k was increased during differentiation of PVAT. Moreover, PVAT from adipocyte-specific RBPJ-k conditional null mice showed alterations in the vasorelaxation pathway including eNOS, with a potential link through PI3/AKT signaling. We are conducting vessel wire myography experiment to further assess the influence of Notch signaling in PVAT on vascular reactivity. Our studies show that Notch signaling regulates metabolic homeostasis of adipose tissue including PVAT. In addition, Notch signaling potentially regulates PVAT-mediated vasorelaxation through eNOS pathways.

1069. Anti-fungal Treatment Efficacy During Polymicrobial Infection

Submission Category: Biomedical Sciences

Author(s):

- Siham Hattab
- Jennifer Quezada-Loja
- Anna Maria Dagher
- Avery Bond

Faculty Mentor: Robert Wheeler

Abstract:
Polymicrobial infections are challenging to treat because of lack of understanding of how pathogens interact during infection and how these interactions affect drug efficacy. Candida albicans is an opportunistic fungus that can cause invasive candidiasis with 40 % mortality in hospitals. Pseudomonas aeruginosa is the most important pathogen responsible for respiratory tract infections in cystic fibrosis (CF) patients. Both pathogens can be found in the lungs of CF

and mechanically ventilated patients. In our research project, we investigated the efficacy of anti-fungal treatment during C. albicans-P. aeruginosa co-infection. We have performed in vitro and in vivo experiments using the zebrafish swimbladder infection model. This infection model is a powerful tool that provides a simple environment that mimics mucosal infection in human lungs. Because of the zebrafish's transparency, this allows us to monitor complex interactions between host and pathogens. Our results suggest that treatment with fluconazole (Flc), an antifungal drug that stops the growth of C. albicans but doesn't kill the fungus, is effective at killing C. albicans during co-infection. This potentiation of antifungal efficacy during co-infection suggests a synergy between Flc treatment and the bacterium. Our current goal is to understand how P. aeruginosa causes this synergy with the anti-fungal drug. Our preliminary data suggest that iron chelation, stripping iron from the environment, might be one of the mechanisms involved in this synergy. This work will help us identify future therapeutic targets to treat C. albicans infection and gain new insights into how the presence or lack of iron affect response to antifungal treatment

1070. Development of a Novel RAB27a Knockout Strain to Study Adipose-Vascular Signaling in Vivo

Submission Category: Biomedical Sciences

Author(s):

- Ashley Soucy
- Larisa Ryzhova
- Anne Harrington
- Benjamin Tero
- Bethany Fortier

Faculty Mentor: Lucy Liaw

Abstract:
Perivascular adipose tissue (PVAT) is a specialized adipose depot that surrounds the vasculature. During obesity, PVAT exhibits a lipid storage phenotype and secrets inflammatory factors which can be detrimental to vascular function. When comparing endogenous protein expression between healthy and obese mice, we found a dramatic increase of RAB27a protein levels in PVAT. A member of the Ras-related protein family, RAB27a is a trafficking protein that regulates the formation and secretion of exosomes. Dysregulation of exosome secretion has been linked to various diseases including type II diabetes and increased heart muscle deterioration. However, the role of RAB27a has yet to be defined in PVAT regarding exosome secretion and

cardiovascular disease. We hypothesize that increased RAB27a expression in PVAT during obesity alters PVAT-derived exosome signaling.
To test our hypothesis, we developed a novel Rab27a global null mouse, characterized by an ashen coat color that mimics type II Griscelli's syndrome in humans. These mice are a good model for studying how obesity alters PVAT-vascular communication without RAB27a, as the strain remains susceptible to diet-induced weight gain. Additionally, isolated aortas with intact PVAT from Rab27a global null mice exhibit a reduced contractile response when treated with phenylephrine compared to wild type mice - suggesting that loss of RAB27a may regulate vascular contractility. With these mice, we now have the tools necessary to investigate how obesity utilizes RAB27a to regulate adipose-vascular communication via exosome-mediated signaling.

1071. Mycobacterium abscessus Cluster R Prophage Genomic Analysis

Submission Category: Biomedical Sciences

Author(s):

- Madeline Kimble
- Colin Welch
- Dakota Archambault
- John Ross
- Jacob Cote

Faculty Mentor: Sally Molloy

Abstract:
Mycobacterium abscessus (Mab) is an emerging lung pathogen of cystic fibrosis patients. It is one of the most drug-resistant pathogens and infections typically result in high morbidity and mortality. Understanding mechanisms of antibiotic resistance is critical for developing more effective treatments. Prophage, integrated viral genomes, are known to contribute to bacterial virulence and antibiotic resistance, yet Mab prophages remain largely uncharacterized. My research aims to characterize the diversity of novel cluster Mab R prophage genomes. The Molloy lab has demonstrated that the prophage McProf increases mycobacterial resistance to antibiotics. Using the McProf prophage genome, we probed the PATRIC M. abscessus database to identify bacterial strains that carry prophage genomes related to McProf. We identified 25 related genomes, 8 of which were unique. This group of prophages are genetically distinct from prophages already described and we assigned them to a new Mab cluster, R. Prophage genome ends were defined, and prophage sequences were extracted from bacterial genomes. MabR genomes are highly conserved, particularly across the structural genes in the right arm and the

immunity cassette in the left arm. All nine genomes share a tyrosine-integrase and nearly identical attachment sites. Interestingly, the immunity repressor is unique to known Mab prophages but is found in tthe M. tuberculosis phage, DS6A. In future research we will investigate the role of novel genes within cluster MabR prophages. All nine members share a secreted polymorphic toxin system adjacent to the right attachment site.

1072. Characterization and Comparative Analysis of Prophage in Antibiotic Resistant Mycobacterial Genomes

Submission Category: Biomedical Sciences

Author(s):

- John Ross
- Madeline Kimble
- Colin Welch
- Anna Schumann
- Dakota Archambault

Faculty Mentor: Sally Molloy

Abstract:
Mycobacterium abscessus is a highly resistant nontuberculous opportunistic pathogen, that causes pulmonary and disseminated infections in individuals with underlying diseases, such as cystic fibrosis. Infections are incredibly difficult to treat due to extensive drug resistance. Understanding intrinsic and acquired resistance mechanisms is important for developing effective treatments. Prophage, integrated viral genomes, are known to alter drug resistance in Escherichia coli, but their role in mycobacterial drug resistance is not yet known. Oftentimes prophage carry genes which increase the overall fitness of their bacterial hosts. In M. abscessus however, the prophages remain poorly characterized. Characterization of these prophage and the genes they encode may provide more understanding of how prophage could contribute to virulence and drug resistance. The Molloy Lab recently demonstrated that the mycobacterial prophage, McProf, alters expression of intrinsic resistance genes in M. chelonae. McProf is included in the cluster MabR, a novel cluster of M. abscessus bacteriophage, which have not yet been characterized. In this project, we compare the genomes of two novel MabR phages, prophiFSQJ01-1 and prophiFSIL01-1 to McProf. These genomes are 76,665 and 66,497 base pairs long and encode 119 and 97 genes, respectively. Like McProf, these novel prophage encode Esx secreted polymorphic toxin (PT) systems however the C-terminal polymorphic toxin motif of prophiFSQJ01-1 differs from the Tde-like DNAse motif found in the McProf and

prophiFSIL01-1 genomes. We hypothesize that these PT systems may allow the bacterium to respond to stress, such as antibiotics, in the environment.

1073. Antimicrobial Agent Cetylpyridinium Chloride Inhibits Immune Mast Cell Function

Submission Category: Biomedical Sciences

Author(s):

- John Burnell
- Bright Obeng
- Christian M. Potts
- John E. Burnell
- Bailey E. West
- Julie A. Gosse

Faculty Mentor: Julie A. Gosse

Abstract:
Cetylpyridinium chloride (CPC) is a positively charged antimicrobial in consumer products such as mouthwashes at concentrations up to 3 millimolar, thus exposing humans to high concentrations. Minimal information on eukaryotic toxicology of CPC exists; hence, there is need for information since humans and wildlife are exposed. Mast cells, ubiquitous throughout the body, are central in numerous physiological processes and diseases. We have demonstrated that CPC potently inhibits antigen-stimulated RBL-2H3 mast cell functioning, including their ability to degranulate, which is the release of bioactive substances including histamine, from intracellular granules. Degranulation inhibition occurs at non-cytotoxic CPC doses as low as 1 micromolar, ~1000-fold lower than the concentrations of consumer products. We have investigated the molecular mechanisms underlying the inhibition of mast cell degranulation by CPC. We have shown that CPC inhibits the antigen-stimulated influx of Ca2+, a core mediator of the degranulation pathway, via plasma membrane channels, into the cytosol. Elevated Ca2+ concentration in the cytosol is required to activate various Ca2+-dependent enzymes and processes, including microtubule polymerization. Microtubules serve as “railroad tracks” to transport the granules to the plasma membrane for fusion and degranulation. Here, we show that 5 or 10 micromolar CPC shuts down microtubule polymerization within 60 minutes. This research provides biochemical mechanisms underlying the effects of CPC on immune signaling and allows prediction of effects on cell disparate cell types that share similar signaling and cytoskeletal elements.

1074. Distance Vitals

Submission Category: Biomedical Sciences

Author(s):
- Kiana Goodwin
- Callie Witt
- Allie Nutting
- Ethan Saville

Faculty Mentor:
- Michael Mason
- Robert Bowie

Abstract:
In recent years, popularity has grown for search and rescue teams to utilize drones to detect and locate a missing person(s). Without physically coming into contact with the individual, the necessary technology and ability are lacking to precisely measure an individual's vital signs (i.e., breathing rate, pulse rate, and temperature). To assist in rescue efforts, a device has been designed to analyze videos and photographs that determine the vital signs of incapacitated individuals. A program was constructed to utilize the Eulerian video processing technique and a Raspberry Pi, allowing for rescue scene information to be extracted and analyzed from a secure digital (SD) memory card. Five critical aspects of the device were tested to ensure quality and functionality and are as follows: (1) testing of the primary programs written to split a video into frames for analysis, (2) testing the pulse rate program, (3) testing the body temperature detection program, (4) determining the functionality of the video stabilization program, and (5) testing the reliability of the breathing rate program all against a control where the vitals are found using equipment known to produce reproducible values. To tie the device together, all programs are compiled and tested for functionality. The results demonstrate that patient vital analysis can be performed via remote access in search and rescue environments.

1075. Low Dose Arsenic Exposure Alters the Expression of MicroRNAs in the Innate Immune Response to Pseudomonas aeruginosa Infection.

Submission Category: Biomedical Sciences

Author(s):
- Liz Saavedra Perez
- Brandy L. Soos

- Carol H. Kim

Faculty Mentor: Benjamin L. King

Abstract:
The innate immune system is essential for responding to different types of infections, injuries and that response can be altered by environmental toxicants. Low-dose arsenic exposure can perturb and dysregulate the innate immune response. In Maine, it is estimated that 10% of private wells are contaminated with arsenic. Exposure to arsenic can lead to decreased overall innate immune function and decreased host's ability to fight infections by opportunistic pathogens, like Pseudomonas aeruginosa, but the mechanisms are not well understood. We utilize the zebrafish (Danio rerio) as a model system to study how arsenic alters the innate immune response to infection. To further understand these mechanisms, our lab focuses on the highly conserved non-coding RNAs, microRNAs, responsible for regulating the protein-coding genes behind these processes. The expression of microRNAs was characterized in 48 hours post-fertilization (hpf) embryos infected with Pseudomonas aeruginosa at 6 and 18 hours post-infection (hpi) following exposure to 0, 2, and 10 ppb arsenic. The highest number of differentially expressed microRNAs in response to infection at 6 and 18 hpi were in embryos exposed to 2 ppb arsenic with 81 and 87 microRNAs, respectively. Dre-Mir-722-P1_3p, previously described to reduce neutrophil chemotaxis to sites of injury or infection, is normally upregulated in response to infection. At 6 and 18 hpi, it was downregulated with increasing concentrations of arsenic. These studies, combined with survival and bacterial burden studies, will provide new insight into the mechanisms of innate immune responses and inform on the dysregulating effect of arsenic.

1076. Computational Analysis and Classification of SHG Images of Cancerous Pancreatic Tissue Based on Collagen Fiber Alignment

Submission Category: Biomedical Sciences

Author(s): Gerren Welch

Faculty Mentor: Karissa Tilbury

Abstract:
Pancreatic cancer is a deadly disease, with a low five-year survival rate partly due to the difficulty in diagnosing the cancer early in its development, as it shares symptoms with more common and less lethal conditions. Using Second Harmonic Generation (SHG) microscopy and computer analysis, our knowledge of the biophysics of the pancreatic tumor microenvironment

increases which may lead to the development of more effective therapies. In collaboration with Maine Medical Center Research Institute (MMCRI), we have identified 20 pancreatic cancer patients. In these 20 pancreatic cancer patients, Dr. Jones, a pathologist at MMCRI has identified normal adjacent pancreas, fibrotic pancreas tissue, and tumorous pancreas tissue. Using SHG imaging microscopy with an 890 nm excitation laser and collection via a 445/20 bandpass filter in the forward direction, we imaged the collagen primarily around pancreatic ductal structures, which studies have shown to be common tumor origin sites1. OrientationJ, a Java plugin in ImageJ, uses a structure tensor to quantify morphological changes in the collagen fibers within the extracellular matrix. In this analysis, the quantitative orientation measurement function built into OrientationJ provides orientation and coherency values for regions of interest selected by the user. Collagen within the ECM generally has a random, basketweave pattern, but in other cancerous tissues there are studies which show a correlation between progression of cancer and the increased aligning of the collagen fibers2,3. We anticipate finding quantitative biophysical alterations that are distinct between cancerous, fibrotic and normal adjacent collagen organizations.

1077. Investigation of the Relationship between Black Soldier Fly Larvae Pathogen Suppression and Growth Substrate in Relation to Maine Agricultural Industries

Submission Category: Biomedical Sciences

Author(s):

- Haley Morrill
- Marissa Kinney
- Emily McLaughlin
- Matthew Moyet

Faculty Mentor: Edward Bernard

Abstract:
Insects are promoted as cost-effective and sustainable protein sources for animal feed. Their utilization may help to avoid a predicted global protein shortage. Black soldier fly (Hermetia illucens) larvae (BSFL) grow on organic wastes, converting these wastes into larval biomass which can fulfill this purpose. BSFL suppress the growth of some gram-positive and gram-negative human pathogens in these substrates; though suppression of *Bacillus cereus*, a spore-forming bacterium that causes food-poisoning, has not been documented. Potential benefits of using BSFL to remediate organic wastes include reduction of waste mass and bacterial load, along with the sale of larvae as a protein supplement. This project focused on *Bacillus cereus* suppression by BSFL on byproducts (used as growth substrates) of 2 Maine

agricultural industries: potatoes and blueberries. Colony counts on B. cereus selective media were higher for larvae fed on potatoes spiked with pathogen than pathogen alone on potatoes after 2 days. After 4 days, an opposite effect was observed, with lower colony counts observed for larvae fed on potato with *B. cereus* than pathogen alone on potato. Blueberry substrate was not capable of supporting *B. cereus* as colony counts for all treatments were below the detection threshold after 2 days of larval feeding. While 100% viability was observed for BSFL reared on blueberries, larval weight decreased by an average of 82% with pathogen compared to a 32% decrease without pathogen. Additional PCR analysis of pathogen presence is in progress.

1078. Comparative Genomic Analysis of Prophages in Clinical Isolates of Streptococcus agalactiae

Submission Category: Biomedical Sciences

Author(s):

- Caitlin Wiafe-Kwakye
- Andrew Fournier
- Katie Southworth
- Hannah Maurais
- Brandon Rockwell
- Caiden Fraser

Faculty Mentor: Melody Neely

Abstract:
Prophages, viral genomes integrated into bacterial genomes, are known to enhance bacterial colonization, adaptation, and ecological fitness providing a better chance for pathogenic bacteria to disseminate and cause infection. Streptococcus agalactiae typically carries one or more prophages, yet their role in pathogen fitness and virulence has not yet been described. Approximately 50% of babies born through vaginal delivery from women colonized with S. agalactiae develop life-threatening infections, such as sepsis and meningitis. However, antibiotic treatment of these infections has long-term negative effects on neonatal microbiota. Characterizing the role of prophages in disease pathogenesis of S. agalactiae could lead to development of alternative treatments. We performed comparative genomics, of prophages extracted from the genomes of 8 previously uncharacterized S. agalactiae vaginal isolates and prophages extracted from published sequences of 5 clinical isolates of S. agalactiae. Dotplot analyses, to explore genome synteny of the extracted prophage sequences, found that they can be grouped into seven distinct clusters. Comprehensive annotation revealed that all S. agalactiae prophages encode paratox, a protein that prevents the uptake of DNA in Streptococcus along

with an associated toxin, hol-tox. Furthermore, each prophage genome has at least one toxin-antitoxin system. Investigation is currently underway into the genomes of over 40 previously uncharacterized S. agalactiae vaginal isolates to identify and extract prophage genomes. Additional analyses of the prophage genomes are being performed to identify genes that may be associated with S. agalactiae pathogenesis. Ultimately, these findings may lead to the identification of potential targets for alternative therapeutic approaches.

1079. The Effects of Common Water Contaminants on Zebrafish Mitochondria Function and Behavior

Submission Category: Biomedical Sciences

Author(s):

- Audrie French
- Noah Burby
- Grace LaFrance
- Patrick Fleming
- Marc Thibodeau

Faculty Mentor: Remy Babich

Abstract:
Many individuals, including children across the state of Maine rely primarily on well water, which can have contaminants that contribute to a number of health deficits. Making sure the water is free of contaminants is important for the health of everyone who uses it. While the US EPA sets limits for toxicity of individual contaminants, data on interactive effects of metals mixtures are lacking. To test for physiological effects of exposure to drinking water samples, we conducted a series of mitochondrial and behavioral assays using zebrafish, Danio rerio. Well water samples from locations across Maine and New Hampshire were collected then analyzed for key metal contaminants. Zebrafish embryos were exposed to a 50% dilution of the water sample starting at 1 or 24 hours post fertilization (hpf) for mitochondrial function and behavioral assays respectively. At 25 hpf, mitochondrial function was determined by measuring oxygen consumption rate (OCR), additionally a subset of embryos exposed from 1 day post fertilization (dpf) to 5 dpf were used to measure exposure impact on behavior via a light dark test, in which total distance traveled over a 25 minute period was extrapolated. OCR and behavioral data were compared to the levels of contaminants in the corresponding well water samples. There were no statistically significant effects on zebrafish mitochondrial respiration or behavior in single metal analysis at levels below the EPA thresholds, though there was a significant difference between single and dual metal toxicity in the water samples with regard to its effect on mitochondrial

function and behavior. Our research confirms the validity of the established metal toxicity thresholds set by the EPA, but suggests that metals could be acting in mixture to cause problems such as altered mitochondrial function and behavior in developing zebrafish - effects which should be further investigated as they may apply to humans. Further research is necessary to evaluate the differences between single metal and mixture toxicity and its effects on embryonic development.

1080. The Optimization of RT-LAMP Testing from Wastewater for SARS-Cov-2 Detection

Submission Category: Biomedical Sciences

Author(s):

- Harrison Cyr
- Kettie Cormier
- Audrie French

Faculty Mentor: Robert Wheeler

Abstract:
Having tragically ended the lives of over 500,000 people in the USA alone and having impacted many more, the COVID-19 pandemic has undoubtedly been one of the most influential events in recent history. One of the most important aspects of controlling this pandemic is effective and large-scale testing, and my project is focused on helping to improve the University of Maine's testing capabilities. In addition to the nasal and saliva testing that is widely used, wastewater testing is capable of detecting an increase in infection before infected individuals even develop symptoms. Along with two other undergraduate researchers, this project has been focused on optimizing wastewater and saliva testing using RT-LAMP, an alternative technology to qPCR that allows for the detection of the virus. The allure of RT-LAMP is in its speed, reduced cost, and ease of use as compared to typical qPCR. My place in the project has been working on several smaller goals to help the project as a whole. Some of these goals include: generating and quantifying positive control DNA to ensure our assays are working correctly, developing a method of testing for the more infectious B.1.1.7 variant in wastewater, determining if the extraction of viral RNA can be replaced with a simpler heat treatment method, and analyzing data generated since the fall to establish the precision and variability of our quantification methods.

1081. Dynamic Regulation of Metabolism by the Glucocorticoid Responsive Gene Klf9

Submission Category: Biomedical Sciences

Author(s):
- Ian Gans
- Remy Babich
- Nishad Jayasundara

Faculty Mentor: Jim Coffman

Abstract:
Krüppel-like factor 9 (Klf9) is a feedforward regulator of glucocorticoid receptor (GR) signaling. We asked if klf9 interacts with fkbp5, a negative feedback regulator of the GR implicated in stress-induced psychiatric and metabolic disorders. We show that in zebrafish fkbp5 and klf9 are expressed with exceptionally correlated, GR-dependent oscillatory dynamics. Expression of fkbp5 is basally elevated in klf9-/- mutants, and Klf9 binds sequences in the fkbp5 promoter, suggesting that Klf9 is an incoherent feedforward regulator of the GR-fkbp5 feedback circuit that governs GR activity. Given that both the GR and Fkbp5 regulate metabolism, we asked how loss of Klf9 function affects metabolic rate and gene expression. We found that klf9-/-mutants have a decreased rate of oxygen consumption and overexpress glycolytic genes, the promoters of which are enriched for Klf9 binding motifs. Our results suggest that Klf9 functions as a transcriptional repressor to dynamically regulate cellular glucocorticoid responsivity and metabolic homeostasis.

1082. Pseudomonas aeruginosa Infection Interacts With NF-κB Activation Through Integrin Signaling

Submission Category: Biomedical Sciences

Author(s):
- Daisy Drinkert
- Jon Donnelly
- David Flewelling
- Victoria Mayers
- Sabrina Varga

Faculty Mentor: Benjamin King

Abstract:
Pseudomonas aeruginosa, a gram-negative aerobic bacillus, is an opportunistic pathogen that exhibits antibiotic resistance and commonly infects those with underlying conditions such as Cystic Fibrosis. Low dose arsenic exposure and CFTR mutations, such as those responsible for Cystic Fibrosis, may also contribute to more severe symptom presentation in Pseudomonas infections. Binding of P. aeruginosa pili have been implicated in increasing the expression of NF-kB, a signaling pathway involved in the innate immune response. It has also been shown that P. aeruginosa interacts with beta-integrins and disrupts normal integrin function. We hypothesize that normal response to Pseudomonas infection runs through the integrin signaling pathway. To test this hypothesis we evaluated RNA sequencing data from developing zebrafish embryos in an experiment where CFTR or control morphants were exposed to 0, 2 or 10 ppb arsenic and infected with Pseudomonas or phosphate buffered saline at 48 hours post fertilization. We analyzed differential gene expression in NF-kB regulated genes and beta integrins at 6 hours post infection. We found that NF-kB related genes and beta integrins were upregulated with Pseudomonas infection, CFTR knockdown, and arsenic exposure. This supports our hypothesis that Pseudomonas infection activates the integrin signaling pathway. Disruption of this pathway could decrease the virulence of Pseudomonas aeruginosa. Beta integrin knockdown models paired with these treatments should be studied to further confirm this hypothesis.

1083. Differential Gene Expression in Developing Zebrafish Glomeruli

Submission Category: Biomedical Sciences

Author(s): Daemon Dikeman

Faculty Mentor: Iain Drummond

Abstract:
The kidney maintains body fluid ion and water balance to ensure proper organ function. Blood filtration is achieved by the glomerulus, a specialized structure of highly arborized kidney epithelial cells surrounding vascular capillaries. How the glomerulus forms an intricate filter is not known however defects in this structure lead to proteinuria (protein leakage into the filtrate), a common cause of kidney failure. Our goal was to generate hypotheses for future research on glomerular formation and compare differential gene expression analysis (DGEA) tools by processing pre-existing developing zebrafish glomerulus RNAseq data on the newly updated genome database for zebrafish. Three DGEA tools were selected: DESeq2 for being a pre-established standard used with a prior iteration of the zebrafish genome; limma was ranked the highest overall in a study of DGEA tools; and NOISeq was found to work very well for low replicate counts. Our dataset contained three biological replicates each of whole embryo and

microdissected developing kidney glomeruli in Danio rerio. We planned to use FastQC, Trimmomatic, and STAR to prepare for DGEA (differential gene expression analysis), then put the results into GOrillas and String analysis systems to determine the general patterns, relationships, and trends among the differentially expressed genes, using Principal Component Analysis to test for batch effects. We found that established human kidney disease genes were among the most highly enriched in zebrafish glomeruli, validating the model. We also found many uncharacterized genes were also highly enriched and these were prioritized for functional analysis using Crispr/Cas9 mutagenesis strategies.

1084. Role of cAMP-pathway Regulators on Acute to Chronic Pain Transition

Submission Category: Biomedical Sciences

Author(s):

- Zaid Al-Abbasi
- Ramaz Geguchadze
- Katherine J. Motyl

Faculty Mentor: Derek Molliver

Abstract:
Chronic pain is challenging to treat and maintained by neuronal plasticity in the peripheral nervous system (PNS) and central nervous system (CNS). Furthermore, diagnoses and treatments for chronic pain are also associated with skeletal disorders. One of the most significant molecular changes in the PNS caused by chronic-pain is the cAMP-signaling upregulation. cAMP pathway activation in the CNS produces hyperalgesia, an increase in sensitivity to noxious thermal or mechanical stimuli, while cAMP inhibition reduces hyperalgesia in inflammatory and other pain models. Hyperalgesia plays a critical role in acute to chronic pain transition. Many studies propose the cAMP signaling pathway as a potential target for developing chronic pain therapeutics. Proteins mediating cAMP signaling are organized into complexes by scaffold proteins called A-kinase anchoring proteins AKAPS, such as (AKAP12). Analysis of data in Molliver lab indicated that AKAP12 might be an essential scaffold for sensory neurons. There are three isoforms of this protein that may form different complexes. Therefore, I generated inflamed mice by injecting them with carrageenan to determine how AKAP12 is regulated by inflammation in sensory neurons. Also, during my current rotation in the Motyl lab, I treated osteoclasts with the β-adrenergic-receptor agonist isoproterenol and examined its effect on the regulation of AKAP12. We identified the three isoforms in multiple mice tissues, with varied responses of the isoforms to the carrageenan-generated inflammation, and to isoproterenol in

osteoclasts, indicating a different cellular expression-pattern of each isoform. Following, I will expand the investigation of AKAP12 isoforms' roles in regulating cAMP-induced chronic pain.

1085. Role of cAMP-pathway Regulators on Acute to Chronic Pain Transition

Submission Category: Biomedical Sciences

Author(s):
- Zaid Al-Abbasi
- Ramaz Geguchadze
- Katherine J. Motyl
- Derek C. Molliver

Faculty Mentor: Derek Molliver

Abstract:
Chronic pain is challenging to treat and maintained by neuronal plasticity in the peripheral nervous system (PNS) and central nervous system (CNS). Furthermore, diagnoses and treatments for chronic pain are also associated with skeletal disorders. A major signaling pathway in the PNS implicated in chronic pain is the activation of adenylyl cyclases to produce cAMP. cAMP production in peripheral sensory neurons produces hyperalgesia (an increase in sensitivity to noxious thermal or mechanical stimuli), while cAMP inhibition reduces hyperalgesia in inflammatory and other pain models. cAMP signaling also appears to play a critical role in the transition from acute to chronic pain. Proteins mediating cAMP signaling are organized into complexes by scaffold proteins called A-kinase anchoring proteins AKAPS, such as AKAP12. Recent analysis of data in the Molliver lab indicates that AKAP12 may be an important scaffold for cAMP signaling in sensory neurons. There are three isoforms of this protein that may form different complexes. Therefore, I used RT-PCR to demonstrate that all three isoforms are expressed in dorsal root ganglia (DRG, which contain the peripheral sensory neurons. Next, we injected mice in the hindpaw with carrageenan as a model of inflammatory injury, to determine whether AKAP12 expression is regulated in response to inflammation in sensory neurons. Using real-time PCR, we found that AKAP12 isoforms are differentially regulated in DRG in response to inflammation. In complementary experiments during my current rotation in the Motyl lab, I treated osteoclasts with the β-adrenergic-receptor agonist isoproterenol, which activates adenylyl cyclase, and examined its effect on the regulation of AKAP12. We found different responses of each isoform to isoproterenol in osteoclasts, indicating a different cellular expression pattern of each isoform. In subsequent experiments, I will expand the investigation of the roles of the different AKAP12 isoforms in regulating cAMP-induced acute and chronic pain.

1086. Investigating the Link Between Aging-Related Vascular Dysfunction and Peripheral Neuropathy through Pressure Myography

Submission Category: Biomedical Sciences

Author(s):

- Bailey Woodard
- Jake Willows

Faculty Mentor: Kristy Townsend

Abstract:
Peripheral neuropathy is any condition that reduces the innervation of peripheral tissues. Pathologies such as diabetes and aging are catalysts for the development of peripheral neuropathy starting in the skin. We previously showed that neuropathy with aging and obesity can worsen over time and reduce adipose innervation as well. Losing proper nerve communication between brain and adipose is detrimental to metabolic health and can worsen obesity or diabetes. Since aging increases the risk for these pathologies, a better understanding of neuropathy with aging is necessary to mitigate them. We have observed denervation around vasculature in subcutaneous white adipose tissue (scWAT) with aging, which is thought to contribute to microcirculation dysfunction and reduced cardiometabolic health. To test the integrity of scWAT vasculature with aging, we are developing a pressure myography system to apply to adipose blood vessels – the first time this has been performed in these tissues. Myography measures myogenic tone and vascular resistance, which may be affected by aging or neuropathy. We will test functional responses and vascular reactivity of an isolated artery from mouse WAT to quantify vascular function. As part of this project, I have spent the past year building and testing a custom pressure myography system and optimizing the microdissection of small blood vessels for mounting. Now that the system is fully built and functional, assessments across aging will commence.

1087. Concentration-dependency of Suppression of *B. Cereus* and MRSA using Black Soldier Fly Larvae in Potato Waste

Submission Category: Biomedical Sciences

Author(s): Daniella Leal Espinal

Faculty Mentor: Edward Bernard

Abstract:
Municipal solid waste (MSW), of which the US is the top global producer, harbors a great number of drug-resistant pathogenic bacteria, making it one of the most important environmental reservoirs of infectious disease. This issue particularly affects marginalized communities who are most often exposed to this biohazardous waste. Gram positive bacteria make up approximately

38% of pathogenic load in all municipal solid waste. The Black Soldier Fly (Hermetia illucens), is a species of fly whose larvae (BSFL) have been shown to suppress pathogenic bacteria. This study sought to better understand BSFL-induced suppression of gram-positive bacterial growth during potato waste remediation under differing larval densities. We investigated suppression of Bacillus cereus and Methicillin-resistant *Staphylococcus aureus*, which are two of the most commonly found pathogens in MSW. Varying larval numbers in each treatment were used to quantify the impact of larval density on pathogen suppression. Some of the methods utilized to assay this impact were suppression disk assays, total and selective bacterial plate counts, and molecular methods. In a preliminary trial made using blueberry waste, the diameter of the zone of inhibition in treatments using 100 larvae decreased by an average factor of 15% when compared to treatments with only 50 larvae. While experiments and data analysis are ongoing, these results may suggest a direct correlation between suppression and larval density. Further investigation will elucidate this relationship.

1088. Receptor Endocytosis Regulates Septin Distribution in Yeast

Submission Category: Biomedical Sciences

Author(s):
- Cory Johnson
- Sarah Latario

Faculty Mentor: Joshua Kelley

Abstract:
G-protein coupled receptors (GPCRs) are the largest, most diverse family of receptors in eukaryotes, and are required for gradient tracking in many eukaryotic cells including neurons. Yeast polarize and grow toward a mating partner through GPCR signaling and the master regulator of cell morphology Cdc42. During polarized growth, yeast deposit cytoskeletal scaffolding proteins called septins at the periphery of the mating projection. In mutant yeast with defective desensitization of GPCR signaling, septin structures are aberrant. We hypothesized that septin distribution is regulated at the level of the receptor. To test this, we used live cell imaging and computational image analysis to observe and quantify septin localization relative to sites of polarity. In our defective GPCR signaling mutant, we find that septin structure changes are dependent upon two negative regulators of Cdc42, the GAPs Rga2 and Bem3. These proteins are known interactors with endocytic proteins called epsins. We next examined epsin signaling in septin deposition and found that the Ent1 exacerbates abnormal septin structures in our mutant strain. Since epsins are involved in receptor endocytosis, we investigated septin distribution in yeast lacking the receptor cytoplasmic tail, which are unable to undergo epsin-mediated

endocytosis. We found that receptor mutants do not appear to rescue the septin defects found in our GPCR signaling mutant. Instead, receptor mutants are unable to selectively deposit septins, leading to aberrant septin distribution. Our results suggest that selective receptor endocytosis is critical to proper septin distribution, which may provide insight for future research in neuron development and disease.

Late Breaking Abstracts

Table of Contents

UMSS21 Book of Late Breaking Abstracts
Presentation List by Category

Physical and Mathematical Sciences

Allied Health

Engineering and Information Sciences

- Masoud Rais-Rohani

Social Sciences and Humanities

713. The Impact of COVID-19 on Social Work Practice

- Brianna Graves Raven
- Jamie Lovley
- Jamie Corbett
- Elizabeth Depoy

724. Stigma Surrounding Currently or Formerly Incarcerated Individuals Within MSW Students

- Brittney Beaulieu
- Karen Quirk
- Jesse Lucas
- Elizabeth Depoy

747. A Qualitative Analysis of Lesbian and Gay Coparenting

- Sara Hunt
- Daniel Puhlman

Natural Sciences

866. Development of a Cannabis Harm Reduction Course for Land Grant University Students

- Abigail Wiegand
- Jennifer Perry

870. A UAV-based Remote Sensing Platform to Detect Spatial Variation of Wild blueberries for Precision Agriculture.

- Kallol Barai
- Yongjiang Zhang

Interdisciplinary Research

907. Pandemic Film and COVID19 in the United States

- Danielle Blair
- Justine Molloy

- Nikkita Drake
- Maisy Cyr
- Nichole Webber
- Elizabeth DePoy

Biomedical Sciences pgs.

1089. Characterization of prophiG122-2 from Clinical Mycobacterium abscessus strain G122: A Novel Cluster MabA1 Prophage

- Allison Weymouth
- Katelyn Amero
- Sarah MacLeod
- Caitlin Wiafe-Kwakye
- Melody Neely
- Sally Molloy

1090. Mab Cluster C Prophages ProphiA315 and ProphiG190 Provide Mycobacterium abscessus Clinical Isolates with Esx-like Toxin Systems

- Morgan Desiderio
- Nick Cataldi
- Kali Howard
- Daniel Joy
- Harjot Singh
- Anna Yates
- Matthew Cox
- Caleigh Charlebois
- Caitlin Waife-Kwayke
- Melody Neely

1091. An APB on Mab Cluster C prophages prophiG73-1 and prophiA353-2: Armed and dangerous

- Sophie Trafton
- Katherine Stevens
- Ian Harden
- Calvin Curtis
- Marissa Paine
- Brandon Rockwell
- Sally Molloy

1092. Genomic Analysis of Novel Bacteriophage ProphiA311-1

- Timber Mattson
- Chloe Bossow
- Caitlin Wiafe-Kwakye
- Melody Neely
- Sally Molloy

1093. Mycobacterium abscessus ProphageG72-1: no polymorphic toxin but still in with the cluster MabD kin

- Abigail McNally
- Sarah Hinely
- Hailey Walls
- Sally Molloy

1094. Comparison of CRISPR-X and Prime Edit for Saturation Mutagenesis of HBE1 locus cis-regulatory elements

- John Butts
- Ryan Tewhey

Physical and Mathematical Sciences

114. Elastic Behavior of Additively Manufactured Gyroid Structures

Submission Category: Physical and Mathematical Sciences

Author(s): Philip Bean

Faculty Mentor: Roberto A. Lopez-Anido

Abstract:
In order to better utilize the benefits of the additive manufacturing process, a new method of computational design has been proposed. This method would involve using finite element topological optimization processes to best allocate material placement. In conjunction with this, it has been concluded that a topological-optimization is readily altered to present a spatially-varying lattice structure design, which has the potential to greatly improve upon current lightweight designs.
The first step in this process is to understand the behavior of the sparse lattice as its density varies. The gyroid lattice, which has a number of advantages over other common types, was chosen for this research, and finite element analysis has been performed in order to characterize its elastic behavior. From this analysis, a computational-empirical model for elastic properties of gyroids has been generated and, after experimental verification, will be implemented into the design optimization process. [Approved for Public Release - DEVCOM SC PAO #: U1-396]

115. Modelling the Filling of Methane in Heterogeneous Catalyst Support SBA-15

Submission Category: Physical and Mathematical Sciences

Author(s): Sam Bonnevie

Faculty Mentor: Brian Frederick

Abstract:
In the renewable energy field, there is a need for increasingly efficient catalysts and catalyst supports for fuel production. This project began by studying the kinetics of catalysts supported on SBA-15 for biofuel production. The experimental transport properties fell well short of the predicted properties, and efforts are now being made to understand the cause of this. Current work involves running computer simulations of the filling of methane in the micro- and mesopores found in the support. Specific work includes consolidating the data processing of

those simulations, diagnosing limitations and improving the sampling of configuration space under specific conditions. Current goals are to generate data for a select variety of pore diameters and temperatures in order to describe adsorption of methane in the SBA-15 pore structure at four different fillings and analyze neutron scattering spectra that was previously measured at Oak Ridge National Laboratory.

Allied Health

428. Psychotropic Medication Use Among California Youth in Foster Care Amid the COVID-19 Pandemic

Submission Category: Allied Health

Author(s): Amy Sibley

Faculty Mentor: Elizabeth Depoy

Abstract:
Objective: Mental health challenges and medication use for youth have been increasing during COVID-19. Youth in foster care have been disproportionately prescribed psychotropic medications, at a rate of 21-52% compared to 4% of non-foster youth. In 2015 California made changes to their medication policies, and this data was explored to assess the impact of COVID-19 on rates of psychotropic medication use of youth in foster care in California.
Method: This paper examines the extent to which rates of psychotropic medications have changed due to COVID-19, for youth in foster care in California. A literature review was conducted, as well as assessment of the data sets from the California Child Welfare Indicators Project (CCWIP). The CCWIP included measures such as the use of psychotropic and antipsychotic medication among youth in foster care, use of multiple concurrent psychotropic and antipsychotic medications, and court authorizations for psychotropic medications. Data for the first two quarters of 2019 and 2020 were compared.
Results: The rate of youth on psychotropic medications in California has been decreasing since changes to medication policies were enacted in 2015. This study revealed no significant changes to the rates of youth in foster care on psychotropic or antipsychotic medications during COVID-19 compared to the previous year.
Conclusion: The state of California has enacted several best practices in regard to medication policies. These appear to mitigate the risk of overprescribing psychotropic medications to youth in foster care, despite the increase in mental health challenges youth are facing during the COVID-19 pandemic.

Engineering and Information Sciences

557. Nutrient Removal from Recirculating Aquaculture System Water by Adsorption

Submission Category: Engineering and Information Sciences

Author(s): Eliza Costigan

Faculty Mentor: Jean MacRae

Abstract:
Recirculating aquaculture systems (RAS) have grown in popularity in recent years due to their potential to provide a sustainable protein source. This has led to a need for RAS wastewater treatment to remove waste products such as phosphorus. Additionally, there is potential to harvest the wasted phosphorus to supplement the agriculture industry and combat nutrient scarcity. This study investigates a phosphorus sorbent made by Phospholutions for its applicability towards RAS use under fresh water conditions and simulated seawater conditions. Batch tests were performed to investigate the behavior of the sorbent in both time-dependent experiments and equilibrium experiments. These showed that the sorbent does not have a high selectivity towards phosphorus, as more phosphorus was removed from fresh water than simulated seawater. The controlling adsorption mechanism for the rate of binding was investigated by modeling kinetic data to five different models, and it was found that the sole limiting rate step is intraparticle diffusion. Adsorption isotherms were also investigated, and it was found that the Freundlich isotherm fit the data better than the Langmuir isotherm. Column studies were performed to test the sorbent's performance in a plug-flow system, and four different models are currently being analyzed for their applicability to model the breakthrough curve. These models will provide an understanding of the sorbent's behavior under changing salinity levels, the potential for the sorbent to be used for harvesting phosphorus from water, and the potential for serving as a part of the RAS wastewater treatment process.

558. Warpage characterization of 3D-printed 17-4 PH stainless steel via design of experiments

Submission Category: Engineering and Information Sciences

Author(s): Alexander Watson

Faculty Mentor: Brett Ellis

Abstract:
Bound Metal Deposition (BMD) is a novel metal additive manufacturing technology in which a metal powder-binder composite paste is layer-wise extruded to form a part, which is then debound and sintered into a solid metal part. Sintering causes linear shrinkages on the order of 18% for 17-4 PH stainless steel, leading to warping and sometimes fracture of sintered parts. This research investigates this problem by quantifying warpage of BMD 17-4 PH planar specimens via a 12-factor resolution IV fractional-factorial design of experiments. Experimental factors included (a) part geometry (height [2.25-4.50 mm], width [20-30 mm], length [100-150 mm], print bed placement orientation [X, Y], thickness of top and bottom shell [0.6-1.2 mm], triangular infill density [34-64%]), (b) interface (density [67-100%] and thickness [0.15-0.45 mm]), (c) raft geometry (thickness [1.65-4.35 mm]), and (d) process conditions (cooling fan speed [0-80%], hold time after printing [1-12 hours], and furnace position [left side, right side]). The warpages on a total of 36 parts were measured via a Faro HD scanner at four processing points: before removal from print sheet, after removal from print sheet, after solvent debinding, and after sintering. Results indicated print bed orientation and cooling fan speed were the most influential factors after removal from the print sheet. Whereas part height and part hold time were most influential after solvent debinding, part height and length were most influential after sintering. The results of this research improve the understanding of BMD processing, thus, allowing designers to reduce the number of iterations required for additive manufacturing of parts within the desired tolerances.

559. Computational Modeling of Fused Filament Fabrication Process

Submission Category: Engineering and Information Sciences

Author(s):
- Christopher Bock
- Brett Ellis
- Masoud Rais-Rohani

Faculty Mentor: Masoud Rais-Rohani

Abstract:
Thermal gradients introduced in Fused Filament Fabrication (FFF) additive manufacturing cause residual stresses that can lead to warpage and inter-bead delamination. Current voxel-based finite element (FE) modeling approaches neither characterize inter-bead process-dependent properties nor predict delamination. This research seeks to address this problem by introducing a

process-dependent extrusion-path FE model that explicitly simulates deposition and amalgamation processes, bead geometry, and removal of the part from the print bed.
The proposed approach models FFF processes via two sequential simulations. First, a process model simulates temperature distributions throughout a part given a toolpath, print settings (e.g., deposition temperature, bead profile, print-head speed, and build plate temperature), and material properties (e.g., heat capacity, temperature-dependent thermal expansion, and temperature-dependent mechanical properties) assuming conductive, convective, and radiative heat transfer. The temperature field is utilized to calculate mechanical deformations and residual stresses via an assumed anisotropic temperature-dependent plasticity model. Second, a service model simulates deformations and stresses after removal of the part from the print bed.
Twelve polylactic acid (PLA) parts were manufactured and tested within a fractional factorial design of experiment (DOE) to validate the numerical approach. All parts utilized a right-cylindrical shell geometry having a 0.5mm sidewall thickness and open surfaces on the top and bottom faces. Preliminary results indicate numerical simulations agree within approximately 20% of the experimental values.
The resulting simulation approach will allow researchers to quantify process-dependent warpage and residual stresses, while offering an avenue to quantifying process-dependent inter-bead strengths required to estimate process-induced delamination.

Social Sciences and Humanities

713. The Impact of COVID-19 on Social Work Practice

Submission Category: Social Sciences and Humanities

Author(s):
- Brianna Graves Raven
- Jamie Lovley
- Jamie Corbett

Faculty Mentor: Elizabeth Depoy

Abstract:
In the past year, the global coronavirus pandemic has wide-reaching consequences in numerous social work areas that continue to pose challenges in 2021. In 2020, many social work graduate students faced unforeseen difficulties in their field placements or internships. These experiences highlighted the sudden and difficult changes that COVID-19 prompted in the field of social work. As we look ahead to the future of social work practices and dealing with the years of consequences of this pandemic, it is valuable to assess what changes have happened in 2020. “To

remain effective, social workers needed the fortitude to handle discrepancies in information, to surpass barriers to communication, and to find creative solutions for their clients (Gearing Saini, & McNeill, 2007).” For many social work graduate students, being in an internship or field placement offered insight into these many changes.

This project uses a mixed-method approach to answer the questions:
What are Covid-19 changes to social work practices in diverse domains reported by social work students?
How do students experience these social work changes in their professional lives and development?

A mixed-method survey will examine the change to social work perceived by master’s in social work students in the state of Maine placed in field placements during the 2020 COVID-19 pandemic. Building on the research literature investigating social work responses to crises, the data collection will ascertain and measure students' experiences and opinions of social work, respectively specific to student’s field placements COVID-19 protocols and the effects of these protocols on the practice of social work. To examine demographic correlates of opinion and experience, data will be collected on age, gender, and other variables supported in the literature. Both thematic and statistical analysis will be conducted.

719. COVID-19 Attitudes and Compliance Among Social Work Students

Submission Category: Social Sciences and Humanities

Author(s):
- Kayla Thompson
- Molly Warren
- Chloe Reichenbach
- Ashley Nadeau-Belanger

Faculty Mentor: Elizabeth Depoy

Abstract:
The focus of our project, COVID-19 Attitudes and Compliance Among Social Work Students, seeks to determine what attitudes about state-mandated COVID-19 safety measures are held by social work students at the University of Maine and what predicts student’s willingness to comply with guidelines. Exploring attitudes and compliance is critically important to ensure that social workers can continue to offer needed services to their client systems while upholding

public health and safety. This study is a mixed-methods design to answer the following research questions:
What attitudes and public health compliance behaviors are reported by social work students?
How are political identity and levels of fear of Covid-19 illness associated with compliance and attitudes?
The study relies on survey methods that utilize open-ended and closed-ended items to examine the domains of compliance and attitudes toward COVID-19 safety measures. The instrument contains questions regarding adherence to state guidelines, including mask-wearing, social-distancing, self-quarantine, and self-isolation. Further domains are incorporated in the survey to determine attitudes and behaviors regarding social-distancing, self-reported political ideology, measures of empathy, measures of functional fear, and reflection of the social work professional ethical code as a determinant for compliance. It is predicted that social work students, with an ethical duty to help and respond empathically to client systems, will likely comply with state-mandated protocols. Given the political context in which COVID-19 has been portrayed, it is predicted that there will be varying methods of compliance and attitudes related to participant's self-reported political identity and perceptions of fear surrounding COVID-19.

724. Stigma Surrounding Currently or Formerly Incarcerated Individuals Within MSW Students

Submission Category: Social Sciences and Humanities

Author(s):
- Brittney Beaulieu
- Karen Quirk
- Jesse Lucas

Faculty Mentor: Elizabeth Depoy

Abstract:
Existing research on stigma experienced by those who have been incarcerated suggests that individuals who are released from prison face considerable challenges in obtaining access to safe, stable, and affordable places to live and call home, to employment, and to many opportunities afforded to others who have not been incarcerated. Stigma is defined as "an attribute that is deeply discrediting" often perpetrated in words and interactions. In the current context, it is no surprise that words matter when describing people involved in the criminal justice system. Language can have such a significant impact on health, wellbeing, and access to health information and services.

The terminology used in policies, programs, and research publications is often derogatory, stigmatizing, and dehumanizing. Due to this linguistic trend, there are often statutory restrictions placed on previously incarcerated individuals in areas like public and private employment, voting, eligibility for public assistance and housing, financial aid to attend college, firearm ownership, and criminal registration. Given the negative influences of stigma included in the language, policy and social interaction, and the centrality of social workers in helping former inmates to feel comfortable and welcomed in social, economic, and civic life, the goal of the researchers in this study was to understand the views and stereotypes individuals in MSW programs may have or believe. This population was chosen as they are the future of the profession. A mixed-method study was used to answer the following research questions:
What stereotypes and expectations about formerly incarcerated individuals are held by social work students?
What age, crime-related, and gender correlates are associated with the degree of negative stereotype?
The study relied on surveys to gather data from students and the results have been analyzed to inform areas of opportunity for reducing the stigma of current or formerly incarcerated individuals by future social workers.

743. What Personal Resilience Strategies are Used by Social Work Students to Deal With Covid 19 Isolation?

Submission Category: Social Sciences and Humanities

Author(s):
- Alison Hills
- Laurie Flood-Jensen
- Jody Hunter
- Savannah Tuttle
- Alexandra Michaud

Faculty Mentor: Elizabeth Depoy

Abstract:
In January of 2020, COVID-19, an infectious disease, spread worldwide, resulting in a global Pandemic. The guidance offered by the CDC resulted in dramatic changes in our personal lives, work lives, and in our educational settings. As a result, Universities revamped their learning structure, with many transitioning to online courses, with no in-person teacher to student or student to student contact. Due to the unique challenges of the Covid-19 pandemic and the

hardships of isolation, many individuals have experienced high levels of anxiety and stress that can be overwhelming. A literature review was conducted to examine individual personal resilience strategies exhibited during the Covid-19 pandemic. SP. Adhikari et al. (2020) identified positive coping strategies that included an individual's number of outings, interactions with friends, family, and even adopting a pet. Given the importance of enacting mental health supportive strategies in this trying time, this mixed study explores the personal resilience strategies of graduate social work students at the University of Maine. This mixed-method study answered the following research questions; What resilience and coping strategies have been enacted by social work students during the pandemic? What outcomes did students report resulting from these strategies? Data collection relied on surveys administered through email to social work students at the University of Maine. In concert with tenets in the literature, our outcome ratings operationalized personal resilience and coping strategies. To discover unanticipated and undocumented strategies, open-ended questions were added to the survey. Statistical and thematic analysis was used to analyze data and develop conclusions about this important topic.

747. A Qualitative Analysis of Lesbian and Gay Coparenting

Submission Category: Social Sciences and Humanities

Author(s): Sara Hunt

Faculty Mentor: Daniel Puhlman

Abstract:
Coparenting is an important dynamic in families and the literature on how parents with non-traditional gender identities work together is lacking. This qualitative project examines coparenting behaviors applied in families with same gender parents. Four same-gender parents were interviewed through semi-structured interviews that collected information regarding coparenting. Through grounded theory methodology, data was analyzed to develop a model of coparenting in same gender parent households. The results of coparenting techniques were split into three different categories: Communication, Role Determination, and Teamwork. Transparency, honesty, and respect were identified as beneficial, positive coparenting communication qualities. Role determination for same-gender couples was self-described as less dependent on traditional gender roles and more the parent's unique skill sets and personal interests. In couples who identified a parent in the role of the primary caretaker of their child, or "default parent", correlated with the child's birth parent in circumstances where the child was born to the parents. Teamwork was an essential component to coparenting by all participants. Parenting through taking turns with their coparent and playing to the strengths of each parent

were used to reduce stress in coparent and parent-child relationships. Negotiation was used to resolve and reduce coparenting conflicts. Our results of coparenting behaviors used by same-gender parents provide knowledge for future research on coparenting in diverse families.

Natural Sciences

866. Development of a Cannabis Harm Reduction Course for Land Grant University Students

Submission Category: Natural Sciences

Author(s): Abigail Wiegand

Faculty Mentor: Jennifer Perry

Abstract:
Recreational cannabis and THC products have been increasingly legalized across the United States. Maine legalized recreational cannabis for users 21 years of age or older in 2016 and legal sales began in 2020. Despite these legislations, cannabis remains banned on the University of Maine campus due to it remaining a federally illicit drug. Currently, students who are found in violation of the UMaine alcohol and drug policies are required to take a harm-reduction course that primarily focuses on alcohol. Cannabis is a vastly different drug from alcohol, and it best serves our community to provide specific relevant information as it is available. A cannabis harm-reduction 1-hour course was designed and implemented, using evidence-based harm-reduction techniques and current cannabis research. Undergraduate UMaine student participants were recruited over a Zoom pitch in their classes or over social media. Participants attended the course and then completed a self-assessment where they reported their cannabis use habits and opinions. The results will demonstrate the cannabis-related habits and attitudes of UMaine undergraduates, and this will be used to discuss the efficacy of the harm-reduction course and future improvements to it. Upon completion of this study, the course will be officially implemented for use by the UMaine Student Wellness Resource Center as part of the requirements for those who violate the cannabis policy.

870. A UAV-based Remote Sensing Platform to Detect Spatial Variation of Wild blueberries for Precision Agriculture.

Submission Category: Natural Sciences

Author(s): Kallol Barai

Faculty Mentor: Yongjiang Zhang

Abstract:
The wild blueberry farms are semi-natural systems with large spatial heterogeneity. Due to spatial variability of soil properties, soil water retention capability can also be drastically different within a field. But current conventional irrigation practices treat the field uniformly. These uniform irrigation practices may result in over or under application of water resources within a field that affects agricultural sustainability. The use of crop water stress index (CWSI) based on canopy temperature has been studied in many crops and found effective in detecting crop water status. But no previous studies were done on validating CWSI in wild blueberries. Also, monitoring and management of nitrogen fertilizer applications based on spatial variability and needs can improve the nutrient status, growth, development. Limited N in the soil can adversely affect plant health, and over-application causes pollution. Leaf chlorophyll content (Chl) has been used as an indicator of leaf nitrogen status. Remotely sensed NDVI has been used to estimate canopy leaf chlorophyll content based on the reflectance contrast between the red and the NIR wavebands. In our study, a drone-based thermal and multispectral sensor was used to validate CWSI and NDVI in wild blueberry fields, respectively. Linear regression models for estimating leaf water potential from the thermal index CWSI and Chl from NDVI were built, and our initial results show significant correlations. CWSI and NDVI maps were also built, which shows the variability of water status and Chl across the field. By detecting crop water status using the CWSI, irrigation can be intelligently controlled. And NDVI can be used for precision N fertilization to increase overall efficiency and profitability.

Interdisciplinary Research

906. Pandemic Film and COVID19 in the United States

Submission Category: Interdisciplinary Research

Author(s):
- Danielle Blair
- Justine Molloy
- Nikkita Drake
- Maisy Cyr
- Nichole Webber

Faculty Mentor: Elizabeth DePoy

Abstract:
The first cases of COVID-19 (Coronavirus) were identified in Wuhan, China, in December of 2019. In March, 2020, COVID-19 was declared a pandemic by the World Health Organization. Since that declaration, COVID-19 has been detected on every continent. 116,341,687 cases of COVID-19 have been confirmed in 219 countries and territories, resulting in 2,583,675 deaths (as of March 5, 2021). Still, this pandemic is not a new or unstoried phenomenon. Film has been a powerful medium not only in predicting pandemic occurrence but also in examining outcome and illuminating causes, consequences, and lessons learned. As the basis for examining how film informs current and future public health crises, their prevention and resolution, this study examined historic and contemporary pandemic films of varied genres.

This naturalistic study focused on thematic analysis to explore the following query: How do themes in pandemic film inform the current crisis specific to cause, prevention, resolution, and repair? Films created before the start of the COVID-19 pandemic and the experience of COVID-19 for the United States population formed the data source. The researchers selected five relevant films about viral outbreak. Each film was viewed by two independent researchers and thematically analyzed. Meanings were shared and negotiated among the independent viewers and a taxonomic analysis was created. The results of this study are intended to reveal important insights into pandemics and to understand how film can be used as a data source for prevention and management of future public health crises.

Biomedical Sciences

1089. Characterization of prophiG122-2 from Clinical Mycobacterium abscessus strain G122: A Novel Cluster MabA1 Prophage

Submission Category: Biomedical Sciences

Author(s):
- Allison Weymouth
- Katelyn Amero
- Sarah MacLeod
- Caitlin Wiafe-Kwakye
- Melody Neely
- Sally Molloy

Faculty Mentor(s): Sally Molloy

Abstract:
Mycobacterium abscessus causes severe respiratory, skin, and mucosal infections, particularly in immunocompromised and cystic fibrosis patients. Infections are difficult to treat because M. abscessus is typically multi-drug resistant. Most mycobacteria carry integrated viral genomes, or prophages, within their genomes and these are hypothesized to play a role in pathogen fitness. Yet little is known about the prophages of M. abscessus. Studying the gene content of these genomes could reveal how they affect bacterial fitness, virulence, and resistance to treatment. The novel prophage prophiG122-2 is one of two prophage genomes identified in the clinical M. abscessus strain G122 using Phaster. The prophiG122-2 genome was annotated by determining gene starts and functions. ProphiG122-2 is one of 14 genomes belonging to Cluster MabA1. The genome is 61,077 base pairs in length, has a GC content of 59.7% and encodes 111 genes. When compared to other genomes in cluster MabA1, prophiG122-2 shares the same tyrosine integrase and a majority of the genes in the structural region, however it has a unique immunity repressor that is not present in other genomes. ProphiG122-2 also encodes a BrnT/BrnA toxin/antitoxin cassette and a polymorphic toxin system with Type VII secretion system motifs. The polymorphic toxin cassette includes a 114-amino acid Esx-1-like protein, a polymorphic toxin with no identifiable toxin motif, and a likely immunity protein.

1090. Mab Cluster C Prophages ProphiA315 and ProphiG190 Provide Mycobacterium abscessus Clinical Isolates with Esx-like Toxin Systems

Submission Category: Biomedical Sciences
Author(s):
- Morgan Desiderio
- Nick Cataldi
- Kali Howard
- Daniel Joy
- Harjot Singh
- Anna Yates
- Matthew Cox
- Caleigh Charlebois
- Caitlin Waife-Kwayke
- Melody Neely

Faculty Mentor(s): Melody Neely

Abstract:
Infections caused by Mycobacterium abscessus target immunocompromised patients resulting in serious pulmonary and disseminated infections, particularly those with a history of cystic

fibrosis. This pathogen is highly antibiotic resistant, making treatment of infections extremely difficult. Many bacterial pathogens host bacterial viruses, known as prophages, that have been inserted into the bacterial genome. These prophages often contribute to pathogenesis by encoding mechanisms to increase bacterial fitness, including pathogenicity and antibiotic resistance. However, there are gaps in knowledge about how M. abscessus prophages function to impact overall bacterial fitness. We identified two Mab Cluster C prophage genomes in the genomes of clinical M. abscessus isolates A315 and G190. Strain A315 carries only 1 prophage, prophiA315-1, with a genome of 50,949 base pairs, a GC content of 64.3%, and encodes 70 genes. ProphiG190-1 was also the only prophage found in M. abscessus strain G190 and has a genome of 53,071 base pairs in length with 78 open reading frames and a GC content of 64.1%. Both prophages encode an integration-dependent immunity repressor (gp1) next to attL and a Tyrosine integrase adjacent to attR. As with the 16 other MabC cluster prophage genomes, there is a polymorphic toxin cassette with Type VII secretion motifs located next to the right attachment sites. The cassette includes two small WXG100 family proteins, a large polymorphic toxin with a C-terminal ADP-ribosyltransferase motif, and a cognate immunity protein with a deaminase domain. Expression of prophage-encoded toxin systems may provide the pathogen with increased survival strategies.

1091. An APB on Mab Cluster C prophages prophiG73-1 and prophiA353-2: Armed and dangerous

Submission Category: Biomedical Sciences

Author(s):

- Sophie Trafton
- Katherine Stevens
- Ian Harden
- Calvin Curtis
- Marissa Paine
- Brandon Rockwell

Faculty Mentor: Sally Molloy

Abstract:
Mycobacterium abscessus is a ubiquitous non-tuberculosis Mycobacterium (NTM) that causes pulmonary and soft tissue infections in immunocompromised populations. It is highly drug resistant, resulting in a treatment success rate of 45.6%. Prophages (integrated viral genomes) increase bacterial fitness, pathogenicity, and antibiotic resistance in many pathogens, yet there are few studies on prophages of M. abscessus. Studying M. abscessus prophage genome content

may help us better understand M. abscessus virulence and drug resistance and lead to improved therapies. We identified two cluster MabC prophage genomes in the genomes of clinical M. abscessus isolates A353 and G73. ProphiA353-2 in one of three prophages identified in the clinical strain of M. abscessus, A353. The genome is 52,643 bp long, encodes 76 genes, and has a GC content of 63.6%. Strain G73 carries only a single prophage, prophiG73-1, which has a genome length of 52,038 bp in length, a GC content of 63.4%, and encodes 75 genes. Like other 16 members of cluster MabC, both prophages encode an integration-dependent immunity repressor (gp1). Adjacent to the right attachment sites is a leftward transcribed polymorphic toxin system with Type VII secretion system motifs. The cassette includes two small WXG-100 family proteins, a large polymorphic toxin with a C-terminase GH-E nuclease motif, and a cognate immunity protein with an ankyrin repeat motif. Both prophages encode a reverse transcribed HicAB toxin/antitoxin pair that interrupts the lysis cassette. These toxin cassettes may arm the bacterial host with an improved ability to respond stress in the environment.

1092. Genomic Analysis of Novel Bacteriophage ProphiA311-1

Submission Category: Biomedical Sciences

Author(s):
- Timber Mattson
- Chloe Bossow
- Caitlin Wiafe-Kwakye
- Melody Neely
- Sally Molloy

Faculty Mentor: Melody Neely

Abstract:
Mycobacterium abscessus is a ubiquitous bacterial pathogen found in the environment that causes pulmonary and disseminated infections, especially in patients who have cystic fibrosis or an immunodeficiency. Bacteriophages are viruses that can infect *M. abscessus* and become prophages upon integration into the bacterial genome. The prophages can encode for defensive mechanisms that protect the bacteria from environmental stressors, and infection by other bacteriophages. Not much is known about the prophages found in *M. abscessus*, but analysis of their genomes and the mechanisms they use to protect bacteria can help advance treatment against infections. ProphiA311-1 is a prophage extracted from the *M. abscessus* clinical isolate A311 using Phaster. ProphiA311-1 was analyzed and annotated using multiple bioinformatic tools. The prophage genome is 61,507 bps in length, containing 89 genes and no tRNAs. This prophage is part of cluster MabL phages, which only contains four prophages to date that share

similarities in the structural and replication regions. Some of the most notable features of prophiA311-1 include a WhiB1 transcription factor located at gp28, and a forward-oriented WXG-100 family polymorphic toxin system (gp85 – gp87) similar to that found in MabE2 prophage, prophiGD91-4. Gp85 encodes an Esx1-like protein and the downstream polymorphic toxin with an N-terminal WXG-100 motif and C-terminal peptidoglycan endopeptidase RipA toxin. gp87 is an orpham and likely encodes the cognate immunity protein. Prophi311-1 also encodes two orpham proteins, gp83 and 84, that align to WXG-100 family protein and a colicin toxin protein.

1093. Mycobacterium abscessus ProphageG72-1: no polymorphic toxin but still in with the cluster MabD kin

Submission Category: Biomedical Sciences

Author(s):
- Abigail McNally
- Sarah Hinely
- Hailey Walls

Faculty Mentor: Sally Molloy

Abstract:
Mycobacterium abscessus causes pulmonary infections in immunocompromised, and cystic fibrosis patients. Typically, M. abscessus strains are highly drug-resistant and challenging to treat. Prophage (integrated viral genomes) are known to contribute to virulence and drug resistance in other bacterial pathogens yet the prophage of M. abscessus are not well described. We used the tool Phaster to identify two novel prophages in the genome of the clinical M. abscessus isolate G72 (QXAE01000001). ProphiG72-1 is a 50,824 base pair long genome with a GC content of 63.4% that codes for 86 genes. This prophage belongs to cluster MabD, which contains 5 other prophages. ProphiG72-1 encodes an immunity repressor (gp 5) which is shared by only one other prophage, prophiFVLQ01-2 of cluster MabD. ProphiG72-1 does not contain a toxin-antitoxin system but encodes a remnant of a polymorphic toxin system immediately adjacent to the right attachment site. ProphiG72-1 is the only prophage in MabD that does not have an intact Type VII secretion system polymorphic system. It does however encode an SUKH-family immunity protein that is paired with putative polymorphic toxin in prophiFSQJ0-3. ProphiG72-1 also encodes a homing endonuclease gene that has been inserted into the open reading frame of a Cas4 exonuclease. Future research on the gene content of additional M. abscessus prophages could help us better understand how prophage may contribute to antibiotic resistance and increased virulence of their host.

1094. Comparison of CRISPR-X and Prime Edit for Saturation Mutagenesis of HBE1 locus cis-regulatory elements

Submission Category: Biomedical Sciences

Author(s): John Butts

Faculty Mentor: Ryan Tewhey

Abstract:
Cis-regulatory elements (CREs) are essential for the proper regulation of genes and the modification of CREs can dramatically alter expression of associated genes. While some of these changes can be attributed to single mutations, it is often combinatorial changes in regulatory elements that contribute to phenotypic change. To understand the contribution of individual nucleotides a better understanding of the logic underlying CREs is required. Saturation mutagenesis allows for generation of CRE variant pools which can be quantified transcriptionally to elucidate the impact of individual mutations. While many mutagenesis techniques are available, a disadvantage of traditional CRISPR-Cas9 methods is the reliance on indels which cause large aberrations in the genomic background. Techniques have been developed to introduce individual mutations while otherwise maintaining the wild-type enhancer background. Examples include CRISPR-X and Prime Edit. To evaluate these methods, we target the HBE1 promoter in cells with a HBE1:mCherry fusion transcript. Using K562 HBE1:mCherry cells, the impact of specific mutants can be quantified by mCherry fluorescence. Initial CRISPR-X experiments show successful, mutagenesis of the HBE1 promoter and the impacts of these mutations are being determined via FACS of mutated cells. Preliminary Prime Edit experiments are ongoing, and the initial mutation library contains six templates each with a unique HBE1 promoter mutation. Ultimately, the two techniques will be compared for their use in future saturation mutagenesis experiments to further study the logic underlying CREs.