

# NDSU EXPLORE

UNDERGRADUATE EXCELLENCE IN RESEARCH AND CREATIVE ACTIVITY 2017

# WELCOME MESSAGE



**Kelly A. Rusch, Ph.D., P.E.**  
**Vice President for Research and  
Creative Activity**

To students, staff, faculty and our neighbors in the community:

Welcome to the annual NDSU EXPLORE Showcase. Now in its fourth year, this event recognizes and celebrates student excellence in research and creative activity. Undergraduates from many disciplines are presenting projects showcasing the diversity of research and creative interests at North Dakota State University.

Becoming involved in research as an undergraduate student makes an impact. To quote one NDSU EXPLORE student, “Research teaches you real-world skills. You get to learn new things; you really get pushed to your limits. You’re not getting told information, but you have to go out and find information, and that’s a valuable skill in any environment.”

Providing undergraduates with these opportunities would not be possible without the distinguished faculty and researchers who mentor these students, and I applaud their dedication to providing an exceptional learning experience for their students.

This year’s program includes keynote presentations by Mahesh Daas, dean of the School of Architecture and Design at the University of Kansas. Daas is a designer, technologist, theorist, academic leader and an innovator with intersectional work that crosses many disciplinary boundaries. He will be sharing his experience, insights and ideas for new educational models of experiential pedagogy and research to engage undergraduate students. Thank you, Mahesh Daas, for your contributions to this event and to everyone here today to celebrate the creative accomplishments of our students.

We hope you enjoy exploring a part of the student learning experience at NDSU.

A handwritten signature in blue ink, appearing to read 'M. Daas', is positioned below the main text.

# THANK YOU

Thank you to the following NDSU EXPLORE Committee members for helping make this event possible.

## **NDSU EXPLORE Committee:**

### **College of Agriculture, Food Systems, and Natural Resources**

Harlene Hatterman-Valenti \_\_\_\_\_ Plant Sciences

### **College of Arts, Humanities and Social Sciences**

Michael Christenson \_\_\_\_\_ Architecture and  
Landscape Architecture

### **College of Business**

Rajani Ganesh Pillai \_\_\_\_ Management and Marketing

### **College of Engineering**

Achintya Bezbaruah \_\_\_\_\_ Civil and Environmental  
Engineering

### **College of Health Professions**

Amanda Brooks \_\_\_\_\_ Pharmaceutical Sciences

### **College of Human Development and Education**

Gregory Sanders \_\_\_\_\_ Deans Office

### **College of Science and Mathematics**

Katie Reindl \_\_\_\_\_ Biological Sciences

### **NDSU Libraries**

Robert Correll \_\_\_\_\_ Sciences Librarian

Nicole Juve \_\_\_\_\_ Agricultural Science Librarian

Jenny Gasto \_\_\_\_\_ Resource Acquisition,  
Management and Discovery / Architecture  
and Visual Arts Librarian

### **NDSU Student Activities**

Matthew Skoy

### **Research and Creative Activity**

Sheri Anderson, Kay Sizer,  
and Cassie Johnson \_ Research Development Office

# CONTENTS

Schedule \_\_\_\_\_ 2

Guest Speaker \_\_\_\_\_ 2

Oral Presentation Schedule \_\_\_\_ 3

Poster Presentation Schedule \_\_ 4

Abstracts \_\_\_\_\_ 6

# SCHEDULE

All events will be held on the second floor of the Memorial Union

## 8:30-8:45 a.m.

Welcome Remarks

### Great Room

Dean L. Bresciani, NDSU President  
Kelly A. Rusch, NDSU Vice President for Research and Creative Activity

## 8:45-9:30 a.m.

Keynote - "An Inconvenient Education for an Uncertain Future"

### Great Room

Mahesh Daas, Ed. D., DPACSA  
The social, demographic, economic, technological and existential context for higher education has changed significantly in the last 50 years. Old paradigms of undergraduate education rooted in the notions of stable career paths in a predictable world are giving way to new paradigms geared for an uncertain future. Daas will detail select organizational and educational models of experiential/design pedagogy and research that engage undergraduate students in knowledge creation, entrepreneurship and leadership aimed at developing self-actualized individuals who can innovate under conditions of uncertainty.

## 9:30-11:30 a.m.

Student Presentations – Morning Session

Oral Presentations – **Hidatsa Room**  
Poster Session – **Plains Room**

## 11:30 a.m.-12:45 p.m.

Keynote Luncheon for Student Presenters and Mentors

"Thinking, Making, Becoming: Stories of Transformative Education"

Mahesh Daas, Ed. D., DPACSA

### Great Room

## 1-3 p.m.

Student Presentations – Afternoon Session

Oral Presentations – **Badlands and Mandan Rooms**  
Poster Session – **Plains Room**

## GUEST SPEAKER



Mahesh Daas is a designer, technologist, theorist and author whose work crosses disciplinary boundaries. Daas serves as the dean of the School of Architecture and Design at the University of Kansas. His academic career spans two decades at four public universities.

As the first person in his family to attend university and then to immigrate 26 years ago to the United States, Daas' personal mission is to help people succeed through design and transformational education. He stands as a testimony to his parents' faith in education as a pathway to prosperity and progress.

Daas earned a bachelor's degree in architecture from Jawaharlal Nehru Technological University, Hyderabad, India, a master's degree in urban design from Kansas State University, and a doctorate in higher education management from the University of Pennsylvania.

Daas wrote the critically-acclaimed book "Leading with Aesthetics: The Transformational Leadership of President Charles M. Vest at M.I.T." (Lexington Books, 2015). The book chronicles how Vest, Dean William J. Mitchell and others helped transform Massachusetts Institute of Technology from "the gray factory on the River Charles" into a world-class campus for innovative architecture. The book has been hailed by critics as "a tour de force of interdisciplinary scholarship."

His forthcoming book "Towards a Robotic Architecture" (2018, Oro Editions, co-edited with A.J. Wit) is the first comprehensive book on robotics in architecture and features 42 leading researchers from around the world. The book reframes robotics and defines robotics research in architecture here on Earth and on Mars.

Throughout his career, Daas has been honored for his creative achievements, leadership and innovative approach to teaching.

# ORAL PRESENTATION SCHEDULE

## **MORNING SESSION** 9:30-11:30 a.m. - Hidatsa Room

### **Noor Abdelhamid and Benjamin Dalton**

Energy Analysis through Visualization

### **Mitch Musel and Noah Thompson**

Designing Pervasive Energy Games to Impact Behavior

### **Amaniel Mrutu**

An Exploration of Calculus Students' Beliefs about Mathematics

### **Sierra Walker**

AIF: A Universal Regulator on Cell Redox Signaling

### **Anthony Baber**

Nuttall's Primrose Late Summer Life Cycle and Yield Comparing in Perspective to Global Warming

## **AFTERNOON SESSION** 1-3 p.m. - Hidatsa Room

### **Thomas Blommel**

Lattice Gas with Monte Carlo Collision Operator Recovers Lattice Boltzmann Method

### **Shane Hawley**

Bioengineered Leather

### **Nathan Johnson**

Manipulation of Biological Matter Using Electrodeless Dielectrophoresis

### **Jared Melville**

Performance Art on the Streets of London – Will We Watch, Not Interact?

An Analysis of the Hornsleth Homeless Tracker

# POSTER PRESENTATION SCHEDULE

## MORNING SESSION 9:30-11:30 a.m. - Plains Room

### Skylar Anderson-Buckingham

Differential Expression of Hypothalamic Genes in Gonadally Recrudescing Juncos (*Junco hyemalis*): Implications for Regulation of Timing of Breeding

### Janell Burkart and Tammy Joe

Biomechanical Analysis of Hip Angles during a Back Squat with and without Kinesio® Tape

### Yuyang Chen and Louis Miller

Study and Evaluation of Operating Experiences with Existing Geothermal Heat Pump Systems in North Dakota

### Alec Deschene

Soil Salinity at the Fargo Project: How Salty is it?

### Jenna Fischer and Sara Gibbs Schnucker

Dating the Latest Tintah Shoreline of Lake Agassiz: A Geochronologic Puzzle

### Samantha Hoch

NDSU/ARL Bio-Based Polymers Project

### Carrera Horton

Impact Behavior of Bio-based Resins and Natural Flax Fiber

### Alexandra Howatt and Isabel Krum

“Healthy Women are Beautiful Women.” Health and Beauty Practices at the Crystal Palace

### Nathan Johnson and Alec Staiger

Artificially Spun Silk with Incorporated Rifampicin and its Inhibitory Effect on *S. aureus*

### Levi Lucy

Using Topological Data Analysis to Aid in the Effectiveness of Conservation Efforts

### Karissa Malm

Influence of Dexamethasone on Digestive Enzyme Activity in the Maternal and Fetal Pancreas in Beef Cattle

### Haley Marston and Logan Clark

CHRONOQUEST: Our Adventures in a Team-Based, Student-Managed Authentic Geochronology Research Course

### Lauren McIntosh

Effects of L-arginine and Exercise on Heart Rate Variability

### Emily Nelson

The Effects of Short-Term Study Abroad

### Trent Olson

CHRONOQUEST: Locating Sample Sites on the Poorly Expressed Tintah Shoreline of Lake Agassiz Using an Integrative Data Framework

### Michala Palmersheim

Sub Lethal Effects of Neonicotinoids on the Alfalfa Leafcutter Bee (*Megachile rotundata*)

### Kimberly Schaper

Causes of *E. coli* in Fargo Water Basins

### Regina Schimek

Intra-reliability of ImageJ Processing of Ultrasound-derived Cross-sectional Area: Upper Leg Subcutaneous Fat

### Alexandra Sherrard

Physical Activity Reduces Subcutaneous Adipose Tissue in Older Adults

### Donald Veverka

Fetid Marigold Odor Survey

### Yuefan Wang and Junlong Xiang

An Innovative Flat Plate Collector Design for Heat and Cold Collection

### Braden Weight

Mixing of Covalent and Noncovalent Functionalization of Single-Walled Carbon Nanotubes

### Abbey Wohlers

Development of a Bone Void Filling Putty to Release an Antibiotic Cocktail for Total Joint-Associated Infection

### Connor Yaggie

Impact of Drainage Water Management on Soil and Water Quality and Crop Production

### Alexander Zeller

Thermodynamic Analysis of a Manufacturing Facility

**AFTERNOON SESSION** 1-3 p.m. – Plains Room

**Kathryn Bartholomay**

Effects of Sex on the Metabolism of Flunixin in Beef Cattle

**Erica Bordak and Emily Nelson**

A Cure for the Common Good

**Ryan Callahan**

Characterization of LIPI-3 Positive *Listeria monocytogenes* in the Upper Midwest

**Joseph Fehrenbach**

Comparison of Bamboo Fiber Versus Glass Fiber as Composite Reinforcements

**Tyler Follman**

Wind Effects on Herbivorous Insects

**Hailey Greenwalt**

Fargo Project

**Christian Henning, Benjamin Leaf, Daniela Chavarría Umaña**

Automation of the Silk Spinning Process by the Creation of an Electronic Control System

**Haley Hoffman, Tanner Anderson, Cheyenne Peterson**

Gender and Class Identified Through Glass in the Crystal Palace Brothel in Fargo, ND

**Alexis Hoopman**

Toxicity Assessment of Glyphosate on Honey Bee (*Apis mellifera*) Spermatozoa

**Kylie Jensen**

Hill's Thistle Research at Blanket Flower Prairie Scientific and Natural Area

**Shayna Karuman**

Achromatic Annihilation

**Aaron Kinslow**

Flax Fiber Emerging Technology Demonstrators

**Jesstin Krech and Ryan Bares**

Advanced Optical Diagnostics for Airflow Studies at NDSU

**Bethany Limke and Julian Thrash III**

Electronic Signatures of Biomolecules for Sensing Applications

**Jamal Omar**

Role of KISS1/GPR54 Signaling in Airway Remodeling in Airway Smooth Muscle

**Collin Pirner**

Motility Characterization of *Escherichia coli* Isolated From Soil

**Erin Richards**

Mec1- Independent Phosphorylation of Rpa2 N-terminus in the DNA Damage Response

**Alyssa Roberts**

DFT Insights into the Thiol/Thiolate Conversion on the Surface of CdS Quantum Dots

**David Syverson**

Cyanogenic Glycosides in Flaxseed

**Brittany Twiss and Madelyn Pennings**

Evaluation of Fruit and Vegetable Intake of Preschoolers

**Donald Veverka**

Fargo Project Aquatic Survey

**Sierra Walker**

Mutagenicity of DNA Lesion Sequences containing Oxidized & Chlorinated Products

**Braden Weight**

Swelling and Structural Properties of Polymer Microgels: Computer Simulations of a Coarse-Grained Model

**Sarah Whims**

Alyzation of Moisture Content in Natural Flax Fibers

# ABSTRACTS

## Noor Abdelhamid Benjamin Dalton

Energy Analysis through  
Visualization

In order to map the energy efficiency of existing buildings in the City of Fargo, the project will identify, research, photographically document and digitally model a subset of municipal buildings for which energy-use data is available and its collection ongoing. In cooperation with the City of Fargo, we will document municipal buildings using conventional photographic techniques, thermal imaging technology, photogrammetry and digital modeling. Photographic and digitally-modeled documentation produced in this project will be integrated with existing and newly collected energy-use data in order to inform detailed analyses of energy efficiency on the scale of single buildings as well as aggregate types.

## Skylar Anderson-Buckingham

Differential Expression of  
Hypothalamic Genes in Gonadally  
Recrudescing Juncos (*Junco  
hyemalis*): Implications for  
Regulation of Timing of Breeding

Seasonally breeding birds must time their reproduction to match optimal environmental conditions. The transition into breeding condition and gonadal growth are regulated by the hypothalamic-pituitary-gonadal (HPG) axis at multiple levels. Our study focuses on the level of the hypothalamus and examines expression of candidate genes in relation to three potential mechanisms regulating gonadal recrudescence: 1) top-down stimulation and inhibition of the HPG-axis via gonadotropin-releasing hormone (GnRH) and gonadotropin-inhibitory hormone (GnIH), 2) sex steroid negative feedback sensitivity via androgen receptor (AR) and estrogen receptor alpha (ER $\alpha$ ), and 3) sensitivity to stress hormones via glucocorticoid receptor (GR) and mineralocorticoid receptor (MR). We measured hypothalamic mRNA expression of these genes via qPCR in captive male Dark-eyed Juncos (*Junco hyemalis*) held under the same conditions but expressing different stages of gonadal recrudescence in early spring. All males were captured from the same overwintering population, but males from a resident subspecies were in a more advanced stage of gonadal recrudescence than males from a migratory subspecies. We found that residents had significantly higher mRNA expression levels of GnRH, lower levels of AR and ER $\alpha$ , and similar levels of GR and MR. These results suggest decreased hypothalamic sensitivity to sex steroid negative feedback and increased GnRH production as factors promoting gonadal recrudescence.

## Anthony Baber

Nuttall's Primrose Late Summer  
Life Cycle and Yield Comparing  
in Perspective to Global Warming

Nuttall's Evening Primrose is a late summer perennial flower that has a life cycle which adjusts to the continuous changes to the first freeze in the fall. To study success of the Nuttall Primrose, we looked at the plant in natural habitat sites in Buffalo River State Park. So, does the Nuttall Primrose produce more offspring if it flowers earlier or later in respect to the first freeze? We marked 30 sites, checking them weekly and recording changes. The measurements taken were flowering, pollinated or non-pollinated buds, early or late season buds, brown or green fruit, and if those fruit were open. We also collected the fruit and stored them in a freezer to artificially simulate them being frozen. We studied the germination process to obtain accurate results of how many seeds actually were germinated.



## Kathryn Bartholomay

### Effects of Sex on the Metabolism of Flunixin in Beef Cattle

Flunixin is an analgesic agent with anti-inflammatory and anti-pyretic activity used to control fever and inflammation in cattle and horses. The withdrawal period for cattle is four days; however, flunixin residues have been found in cattle slaughtered after the prescribed withdrawal period. It is possible that flunixin is metabolized more slowly in sick animals, resulting in higher flunixin levels at slaughter. There is evidence that there are differences in flunixin metabolism related to the sex of the animal. Therefore, preliminary research is required to ascertain if a sex difference in flunixin metabolism is present in cattle. To explore this hypothesis, background testing was done using subcellular fractions isolated from beef liver, as the subcellular site of flunixin metabolism was unknown. Enzyme activity was determined on fractions to validate enrichment of subcellular fractions, and cytochrome P450 was measured in microsomal fractions. At this point in analysis, no difference was seen between the nmols of P450/mg protein in female (3) and male (5) bovine microsomes which had means of  $1.081 \pm 0.17$  nmol/mg and  $1.085 \pm 0.16$  nmol/mg, respectively. Similarly, females had an average of  $114 \pm 12$  nmol/mg protein of cytochrome C NADPH reductase activity in the microsomes and males had an average of  $118 \pm 16$  nmol/mg protein. The rate of flunixin metabolism is yet to be determined, though mass spectrometry has indicated flunixin metabolism occurs in the microsomes, producing the recognized metabolite, 5-OH flunixin. If female cattle are found to metabolize flunixin more slowly, it may be necessary to have sex-specific withdrawal periods for female cattle.

## Thomas Blommel

### Lattice Gas with Monte Carlo Collision Operator Recovers Lattice Boltzmann Method

We are examining a new kind of lattice gas that closely resembles modern lattice Boltzmann methods. This new kind of lattice gas, that we call a Monte Carlo Lattice Gas, has interesting properties that shed light on the origin of the multi-relaxation time collision operator, and it derives the equilibrium distribution for entropic lattice Boltzmann. Furthermore, these lattice gas methods have Galilean invariant fluctuations given by Poisson statistics, giving further insight into the properties that we should expect for fluctuating lattice Boltzmann methods.

## Erica Bordak Emily Nelson

### A Cure for the Common Good

Melvina Massey was the infamous madam of the Crystal Palace, a brothel in Fargo, North Dakota, in the early 18th century. We were given a selection of twelve bottles from the brothel site to research; nine liquor bottles, one wine bottle and two medicinal bottles. Through the study of these glass bottles, we were able to make interpretations of what life at the brothel may have been like by focusing on three societal factors: class, power and gender. After reading outside sources about the Crystal Palace and other brothels throughout the United States from the same time period, we are confident in making the following interpretations. Due to the type of alcohol in our selection of bottles, we are able to conclude the brothel was of middle to upper class. From integration of outside sources, we know brothels were frequented by men as a way to regain power in the household setting and as a way to relax from the hustle and bustle of societal norms. It is believed the women made the conscious decision to become prostitutes since prostitutes enjoyed a higher wealth status. Women had the agency to create class and move up within the class system; and by utilizing this, the women were able to create a higher class ranking for themselves. Becoming a madam was one way women at the time could gain power in business fields and challenge themes of class, power and gender.

**Janell Burkart**  
**Tammy Joe**  
**K. Lyman**  
**B. Christensen**  
**K. Hackney**  
**K. Stone**  
**J. Brodersen**

Biomechanical Analysis of Hip  
Angles during a Back Squat with  
and without Kinesio® Tape

Astronauts who participate in long-duration space flights have suffered from decreases in skeletal muscle and bone density. In order to attenuate negative physiological effects while in space, astronauts perform back squats; however, increased resistance is required due to zero gravity thereby potentially changing the mechanics.

The purpose of this study was to investigate the application of Kinesio® Tape to mitigate negative biomechanical alterations during a back squat. METHODS: Thirty-two participants (f= 16, m= 16) (age= 34.4 + 7.9) who regularly incorporate the back squat into their exercise routine were recruited. Markers were placed at the greater trochanter of the femur, center of the lateral knee, and lateral malleolus. A Casio Exilim EX-FH20 camera captured sagittal plane movements. 70 percent of one-repetition maximum squat was calculated by having participants perform a maximal voluntary isometric contraction back squat while on an AMTI Accupower force plate. Participants were randomized into one of two groups: Kinesio® Tape during the first or second set of eight repetitions. Kinesio® Tape was applied with two vertical strips along the paraspinal muscles. A third strip was applied horizontally along the SI joints. Four different hip angles in each repetition (16 total) were measured using Dartfish Motion Analysis Software. A repeated measures ANOVA revealed no statistically significant differences between the taped and no tape conditions ( $F[1,32.14]=.499, P = 0.486$ ).

Conclusion: The application of Kinesio® Tape did not affect the angles of the hip at any of the four points in any of the 16 repetitions.

**Ryan Callahan**  
**T. Bergholz**

Characterization of LIPI-3  
Positive *Listeria monocytogenes*  
in the Upper Midwest

*Listeria monocytogenes* is a ubiquitous opportunistic pathogen capable of infecting a wide variety of hosts. *L. monocytogenes* is the causative agent of listeriosis, with most cases of illness being due to foodborne transmission. Listeriosis results in flu-like symptoms in the healthy population but may also result in extreme complications including encephalitis and spontaneous abortion in immunocompromised or pregnant individuals. Listeriosis also has a high mortality rate estimated between 20 to 30 percent. *L. monocytogenes* possesses a number of virulence factors, one of which is Listeria Pathogenicity Island 3 (LIPI-3). The eight genes of LIPI-3 are responsible for the production and post-translational modification of Listeriolysin S (LLS), a bacteriocin that helps establish infection in the intestinal tract. Previous studies on LIPI-3 have focused primarily on gene function using reference strain F2365, and little work has been done on the prevalence of LIPI-3 in *L. monocytogenes* isolates from the United States, specifically the Upper Midwest. In this study, *L. monocytogenes* isolates from the Upper Midwest as well as a handful of reference genomes from around the world were screened for the presence of LIPI-3. Isolates containing LIPI-3 were further categorized using multi-locus sequence typing (MLST) methods. Using this information, phylogenetic trees were constructed to show the divergence of LIPI-3 genes based on MLST subtype. Comparison of the LIPI-3 gene diversity to MLST data showed that the LIPI-3 genes exhibit a higher degree of diversity than MLST genes. Diversity of LIPI-3 genes exists even within clonal complexes established by MLST. Future directions include phenotypic studies and investigation into the self-immunity mechanism of *L. monocytogenes* to protect itself from LIPI-3.

## **Yuyang Chen Louis Miller**

### Study and Evaluation of Operating Experiences with Existing Geothermal Heat Pump Systems in North Dakota

A Geothermal Heat Pump (GHP) system may be considered as a “green” system, due to its use of clean geothermal energy that, as a type of renewable energy, has a large potential for building energy savings and CO2 emission reduction. It is known that a GHP system has the ability to convert underground thermal heat into usable energy at a high efficiency to provide heating and cooling to buildings. Many factors, however, determine the operational performance of GHPs, such as the control strategy, the system age, etc., any of which could have a significant impact on the normal operation of a GHP system. Therefore, in this project, the developing and operating status quo of the existing GHP systems currently installed and used in North Dakota are being studied and evaluated. Specifically, at least 20 buildings equipped with GHPs are involved. Data will be collected through on-site visits and then analyzed for each building with the assistance of computer simulations. These data include the current system operational parameters, the mechanical design documents and the cost analysis related to the purchase, installation and use of GHP systems. The results of this project can be used 1) by the state to review its incentive or tax credit program for geothermal application and then adjust or revise it, if necessary; and 2) to help building owners to identify and solve operating difficulties and improve building performance. This research is supported by the North Dakota Department of Commerce – State Energy Program.

---

## **Alec Deschene**

### Soil Salinity at the Fargo Project: How Salty is it?

The Fargo project is a pilot project to turn a storm drainage detention basin into a community green space and natural area. A significant problem in the area is soil salinity; and in order to mitigate future problems, we need to understand the salinity pattern in the basin. Last year, native prairie plants were planted in the basin to restore historical prairie. This year, some plot areas succeeded while others have suffered. Our main objective is to determine how salty each plot is so that the managers of the project can tailor a seed mix that will work for each plot. When collecting soil, we got an average for each plot by drawing four, 6-8-inch-long by 1-inch diameter, plugs in various areas within each plot. The soil was dried, ground and tested to determine average soil salinity for each plot. The averages will be given to the Fargo Project managers so future action can be taken. This research project is important because many places in and around Fargo deal with the same types of soil, and if a native prairie seed regimen is found to be compatible with these salinity ratios, more native prairie can be restored.

## **Joseph Fehrenbach**

### Comparison of Bamboo Fiber versus Glass Fiber as Composite Reinforcements

The objective of this research is to build a database for Sunstrand, LLC to compare the mechanical properties of bamboo fiber-reinforced thermoplastic composites versus fiberglass-reinforced thermoplastic composites at different fiber loadings, and also to observe the effect of a maleic anhydride surface treatment.

In order to accomplish this objective, 1/4" length bamboo and glass fibers were compounded and pelletized with both polypropylene (PP) and poly lactic acid (PLA) using a co-rotating twin screw extruder and a pelletizing machine. Varying fiber weight fractions were tested with bamboo fiber as the reinforcement both with PP and PLA. Varying fiber weight fractions were also tested for glass fiber with both PP and PLA. Various volume fractions of bamboo fiber were tested with both PP and PLA. In addition to this, maleic anhydride surface treatments were investigated with different bamboo fiber volume fractions with both PP and PLA.

For the testing of mechanical properties, an Instron load frame was used for testing tensile and flexural properties in accordance with ASTM standards D638 (tensile) and D790 (flexural). An Izod impact tester was used to investigate impact properties in accordance with ASTM D256. The expected outcome of this research is to build a cohesive and self-consistent database of bamboo fiber composites versus fiberglass composites to assist Sunstrand, LLC with their product development.

## **Jenna Fischer Sara Gibbs Schnucker T. Olson L. Clark H. Marston K. Lepper**

### Dating the Latest Tintah Shoreline of Lake Agassiz: A Geochronologic Puzzle

The chronology of Lake Agassiz's lake levels are important to decoding the climate changes at the end of the Pleistocene and early Holocene. A leading hypothesis suggests that mass drainage of Lake Agassiz may have initiated the Younger Dryas cooling event. Analysis of Greenland ice core records has put the onset of the Younger Dryas climate anomaly at 12.9 ka. Understanding the ages of lake levels in the Agassiz basin is needed to help correlate a potential drawdown of Lake Agassiz with the onset of the Younger Dryas. There are four major age groupings for Lake Agassiz stable shorelines that span the time period relevant to the Younger Dryas; these ages are the Herman, Norcross, Tintah and Campbell. The Herman, Norcross and Campbell have all been successfully and reproducibly dated using OSL with ages of  $14.1 \pm 0.3$  ka,  $13.6 \pm 0.2$  ka and  $10.5 \pm 0.3$  ka, respectively. Thus far, the Tintah strandline has been difficult to date either due to being poorly expressed on the landscape or being composed of course-grained lag deposits unsuitable for OSL dating; leaving the age of the Tintah lake level unresolved at the present time. In this work, new age results are reported for Tintah shoreline deposits sampled in Marshall and Roseau counties of northern Minnesota. In this region, shoreline deposits have high sand content and strandlines have identifiable geomorphic expression. The team used digitized strandlines, soil surveys and satellite imagery to remotely choose optimum sites for exploration. Samples were processed and dated using OSL SAR techniques on quartz sand. Preliminary age results do not appear to provide clarity to the age of the Tintah lake level and potentially raise difficult questions about the paleohydrologic dynamics of Lake Agassiz during this critical time interval, as well as our current geospatial understanding of Tintah strandlines.

## Tyler Follman

### Wind Effects on Herbivorous Insects

Wind is a regular part of our lives in North Dakota, but little is known about how that wind influences the insects around us. This is especially important to understand as climate change is predicted to further influence wind speeds, which could have further impacts on many living systems and populations. We know wind can influence plants, but it is still relatively unknown how this abiotic factor affects the plant/insect herbivore interaction. To test the effects that wind indirectly has on insect herbivores, specifically the pea aphid, we ran two experiments that tracked aphid population growth. The first experiment used fans to simulate wind while the second experiment studied the direct touching between plants that can occur when wind knocks plants against each other. We then measured the fecundity (number of babies) of the aphids after the wind or touch treatment was applied and found that both treatment types negatively affected aphid performance. While more research is needed on how other species within this food web, like aphid predators, are also affected, this research suggests that wind could potentially be an important component of understanding when and where aphids and other agricultural pests become problems.

## Hailey Greenwalt

### Fargo Project

We are currently looking at a stream in a flood basin in South Fargo near the YMCA. When it floods, this stream holds and transports water back to the Red River. The stream alters our pool and ripple systems in times of heavy precipitation (30-40 cubic feet per second), but also with a small amount of water (15-20 CFS). We are trying to induce natural behaviors, instead of engineering an entirely new stream to hold flood water. This project will be a part of a natural green space known as the Fargo Project which is being created for the city of Fargo to increase aesthetics and flood control.

To measure bank flow, CFS (cubic foot per second) and report how the stream is changing, we used a laser level and recorded the water level per foot, across 20 feet. We measured five cross sections throughout the stream each about 17 feet long and then one cross section 60 feet long, once during the fall of 2015 and the fall of 2016. Our methods were consistent, using the same cross sections, 20 feet across and measuring per foot. We could see that in just one year, the stream had deep trenches by water carrying large rocks during intense rainfalls. A substantial amount of sediment was moved and bank flow increased. This year, we saw that the meander rocky structures allowed for the water to undercut the bank on the adjacent sides. The goal is for the stream to have the ability to hold and transport large amounts of water during times of flood without destroying the structure. We also hope to learn why a stream like this can behave in such unpredictable manners. Our data is not complete due to continuous changes and research in structure and quality for the Fargo Project.

## Shane Andrew Hawley

### Bioengineered Leather

My intrigue and involvement began with the process of making Kombucha. This ancient drink has unclear origins; however, it does not have unclear effects. Within the drink lies the essential formation of the Yeast/Scobi/Mother used to ferment the drink. Drying out this yeast and creating a fabric gives you a pliable, feasible option for a leather alternative. From a product development standpoint, this bioleather can be grown, shaped and colored into whatever dimension you need for textile application. This reduces the need to cut patterns and optimizes construction time.

Ranch production of meat and leather is now the second largest source of pollution on earth. There needs to be alternative ways of looking at bio/eco-friendly textile production that involves minimal environmental impact. Applying this new way of using this material on a textile level can already be found, and I have personally grown, dried and sewn the material. However, I am trying to implement this product into architectural and engineering-based contexts. I need a larger heat-controlled space and the fabrication of glass sheets to grow the specimen, as well as scientific assistance recording the results into cohesive data. This relatively simple process requires a very minimal amount of ingredients with relatively expensive startup costs for tools. This production could open the door for humanity to achieve more conscious ways of producing products ethically.

---

## Christian Henning Benjamin Leaf Daniela Chavarría Umaña A. Brooks B. Hoffman

### Automation of the Silk Spinning Process by the Creation of an Electronic Control System

Spider silk has been the focus of study in many scientific disciplines during recent years due to its versatility and mechanical properties. The desirability and need for tailorable material functions has led researchers to pursue ways to artificially produce this biomaterial. Extensive research studies at NDSU have led to the creation of a biomimetic silk-spinning device. This device is capable of creating artificial silk fibers using a combination of proteins, ionic compounds, and mechanical shear to mimic the natural silk spinning process of the Golden Orb Weaver spider (*Nephilia clavipes*). However, in the biomimetic process there are still hurdles to overcome. The current device utilizes syringes and tube fittings to apply the necessary spinning elements with a controlled flow rate. This method can lead to asymmetric fluid flow, causing undesirable qualities in the fibers collected from the device. Human error also is a factor, as the current setup requires interaction at several steps in the spinning process. The objective of this study is to create an electronic control system to monitor fluid flow and precisely control all elements of the spinning device. The system will be customizable to deliver the exact flow parameters required for the spinning application. Providing an autonomous control system with integrated monitoring will allow resulting fiber characteristics to be correlated with specific spinning elements. This will lead to far more consistent and efficient fiber creation, while minimizing the human element of the process.

## **Samantha Hoch**

### **NDSU/ARL Bio-Based Polymers Project**

The Army Research Laboratory (ARL) is partnering with NDSU to develop new high-performance bio-based polymers manufactured with renewable resources and sustainable processes. The Coatings and Polymeric Materials (CPM) and Mechanical Engineering (ME) Departments are currently working with ARL to develop a non-isocyanate bio-based polymer to be used as a protective top coat in military applications. Isocyanate, a chemical found in many polyurethane resins, can be potentially hazardous to human health if not handled properly, thus motivating efforts such as this to remove it from resins. The ME Department is currently investigating the use of cellulose nanocrystals (CNC) in bio-based and commercially available resins. These resins can then be used for Stereolithography (SLA) printing to manufacture nano-composites. In addition to being a renewable organic compound, CNCs have a high specific strength and modulus, and when used as a reinforcing agent, can greatly increase material properties. Additionally, their reactive surface allows for surface modification so they can be dispersed into hydrophobic polymers. Various CNC weight percentages will be tested to determine changes in mechanical properties. In the future, the bio-based resins can then be used to create composites with improved properties that can be tailored to fit a variety of possible applications.

---

## **Haley Hoffman Tanner Anderson Cheyenne Peterson**

### **Gender and Class Identified Through Glass in the Crystal Palace Brothel in Fargo, ND**

Melvina Massey was a notorious public figure in Fargo, North Dakota's red light district during the late 1800s and early 1900s. She was probably most recognized due to her position as madam of the Crystal Palace brothel.

The fact that she was an African American woman with this profession and was well-known is truly remarkable. Recent salvage excavations have been done on the Crystal Palace site and have allowed numerous artifacts to be uncovered and made available for analysis. This project seeks to analyze the role certain glass bottles played in enforcing gender norms and maintaining the class status that Melvina Massey had during this time.

## Alexis Hoopman

### Toxicity Assessment of Glyphosate on Honey Bee (*Apis mellifera*) Spermatozoa

During 2016-2017, 33.2 percent of managed honey bee colonies in the U.S. were lost due to Colony Collapse Disorder (CCD). Commonly used pesticides are among the suspected reasons for bee mortality. N-(phosphonomethyl) glycine (glyphosate) is a widely used herbicide in the U.S. and has previously been shown to have behavioral effects on worker honey bees. However, effects of pesticides on honey bee reproductive physiology is understudied, especially with respect to the drone (male) bee. The queen bee receives semen from multiple drones during a once-in-a-lifetime mating flight. The spermatozoa is stored in the spermatheca and utilized for two to seven years. Even small amounts of pesticide-tainted spermatozoa has the potential to affect the queen's fertility for the duration of her life. The purpose of this study was to assess toxicity of glyphosate to honey bee spermatozoa by determining the lethal dose (LD50) and lethal time (LT50). Previous studies elsewhere report that the nectar in a plant sprayed with glyphosate can contain between 0.002-0.0032 mg/ml of the herbicide. Sperm samples were collected from drones returning from the mating flight and treated with glyphosate dissolved in dimethyl sulfoxide to determine the LD50 and LT50, respectively. After exposure, sperm samples were subjected to motility and live/dead assays. Preliminary results support the hypothesis that glyphosate negatively affects honey bee spermatozoa. At 40 minutes of exposure time, the LD50 concentration was found to be 0.31mg/mL ( $p < 0.0001$ ). At 0.05mg/mL concentration of glyphosate in the semen, the LT50 was found to be 468 minutes ( $p = 0.009$ ).

## Carrera Horton

### Impact Behavior of Bio-based Resins and Natural Flax Fiber

A growing social consciousness exists surrounding the use of bio-based composites to replace traditional materials in various applications. A desire for renewable composite materials has led to new research and development in the Advanced Materials and Composites Research Group at NDSU. The objective of this study is to test the impact behavior of new resins developed at NDSU in composite materials utilizing flax, a renewable natural fiber. Bio-based resin composite samples were manufactured and subjected to low velocity drop tower impact testing and compared with samples made with vinyl ester resin. It was observed that the bio-based composites performed similarly to the traditional vinyl ester composites; however, improvements can be made concerning processing techniques, the bonding between fiber and resin, and overall impact strength. Future studies are planned utilizing previously successful alkaline treatments and new bonding techniques in hopes of creating a stronger bio-based and renewable composite material.



## Alexandra Howatt Isabel Krum

“Healthy Women are Beautiful  
Women:” Health and Beauty  
Practices at the Crystal Palace

The discovery of artifacts connected to the Crystal Palace in Fargo, ND, has given local archaeologists and historians the opportunity to learn more about black businesses and sex work in Victorian Fargo. Melvina Massey, a black woman, ran the brothel in the late 1800s at a time when women’s societies petitioned for the abolishment of liquor sales and sex work. Despite this environment, the Palace thrived by catering to middle- and upper-class residents and visitors, and the rooms, the drinks and the (working) tenants were held to a high standard. We aimed to connect our assemblage to this part of Massey’s business savvy.

Using the Society of Historical Archaeology’s bottle dating and typing guides, as well as miscellaneous guides for specific glassmakers’ bottles, we dated 13 of our 14 bottles to Massey’s time and classified most as either pharmaceutical or cosmetic. Further research investigated medicinal practices and gender performance in the Victorian era. While some of our pharmaceutical bottles contained medicine for specific illnesses, many medicines were also used for different diseases than intended. We reason that because health was connected to beauty, the presence of many pharmaceutical bottles indicates attention to beauty as well as health. Our interpretation of this data and reasoning is that Massey and her sex workers retained an amount of control over their bodies and used their bodies to their advantage. This would indicate a measure of choice and business savvy in participating in prescribed gender roles of the time.

---

## Kylie Jensen J. Norland

Hill’s Thistle Research at Blanket  
Flower Prairie Scientific and  
Natural Area

Hill’s Thistle (*Cirsium pumilum var. hillii*) is a species with a specific habitat/range in Minnesota, and is a species of concern in Minnesota. This species is an indicator of undisturbed prairie and acts as a food source for pollinators along with the various fauna that use seed head fibers. The continued loss of prairie has caused a decline in Hill’s Thistle populations in Minnesota. My project helps to identify any change in population numbers at the Blanket Flower Prairie that is at the western edge of its range. I used past population counts/locations of this species to randomly select 10 monitoring sites. At each of these 10 sites, I positioned 50 meter transects and recorded the geographic coordinates. With a team of four to six volunteers, we set up flags at the end of the 50 meter transect at each monitoring site using GPS. The team walked two meters on both sides of the transect counting all thistle individuals. From the belt transect data an estimation of Hill’s Thistle density was made for each transect. Comparing it to past population counts, I learned that this year’s population numbers have declined at 7 of 10 sites. This is important for a larger picture (both at the Blanket Flower Prairie SNA and throughout the range) because as populations continue to decrease from loss of habitat or other factors, the ecosystem benefits from biodiversity may be lost permanently. The sites will continue to be monitored over the years so that year-to-year variation can be estimated.

## Nathan Johnson

### Manipulation of Biological Matter Using Electrodeless Dielectrophoresis

Dielectrophoresis (DEP) holds important application in micro total-analysis systems due to the applicable manipulation of biological particles. When a non-uniform AC electric field applied to an ionic liquid media, polarizable particles (in this case biological matter) within the media can be moved, separated, collected and rotated depending on how the non-uniformity of the field is changed. We can change the field by varying the frequency or by adding a physical object disturbing the electric field. Objects can be either conductors or insulators. When using an insulating object to manipulate an electric field, we enter the realm of Electrodeless DEP (eDEP). Here electrodes are used to create the driving field but manipulation is done by the induced electric field due to an insulating object. For this research, the primary insulating object used is a pulled silica pipette. It is believed that under certain frequencies an attractive eDEP force (in the direction of the pipette tip) can be created to collect biological matter. Likewise, a repelling force can be created under a certain frequency with application of dropping off the biological matter. In order to complete this portion of the research, the primary focus is to prove that the concept of eDEP forces works with the changing of variable pipette tip sizes and shapes, buffer solutions used, etc. (without deviating from the eDEP). When the idea is proven, new implications will be opened on what we can do with eDEP and the most efficient way to do those things.

---

## Nathan Johnson Alec Staiger

### Artificially Spun Silkworm Silk with Incorporated Rifampicin and its Inhibitory Effect on *S. aureus*

The study and development of controlled drug release systems to combat antibacterial resistance is a new and important approach to the problem. Currently, research is being conducted to integrate antibiotics such as rifampicin into spider silk using scientific advancements and breakthroughs in biomimetic spinning. Recently, the Brooks' lab developed an artificial spider silk spinning system that can mimic the biological spinning process (i.e. pH gradients, ionic gradients, and mechanical fluid dynamics) and produce a small diameter silk fiber. On the heels of this success, fibers can be produced using synthetic silk proteins produced with mechanical, electrical, and biochemical characteristics. Spider silk proteins were obtained by both dissolving (1) natural silk (obtained via forcible silking) and (2) recombinant *E. coli* silk protein. Using new microfluidic spinning technology, rifampicin was integrated into a synthetic silk fiber. The antibacterial properties of synthetic fibers with rifampicin were assessed via zone of inhibition studies against *S. aureus*. Data reports from silkworm silk fibers containing the drug show that the zone of inhibition sample averages ranged from 5.34 mm to 10.43 mm. Recombinant spider silk from *E. coli* produced larger, more uniform zones of inhibition ranging from 16.8 to 18.6 mm. Importantly, the size of the silk fibers produced can be related to the zone of inhibition data obtained from the experiments performed. Such antibiotic fibers could potentially be used as ophthalmic sutures to combat antibiotic resistant infections.

## Shayna Karuman

### Achromatic Annihilation

Achromatic Annihilation is a series of photos produced and directed by Shayna Karuman modeled by Natalie Crawford. Within the series, Achromatic Annihilation, the artwork of Yayoi Kusama's "Self Obliteration" is referenced. The artist intends to reflect on her past experiences and share her association with the word and action of assimilation. Through her series, Karuman emphasizes the nature of change she observed and became familiar with as a multiculturally raised teenager. The series was shot in the span of one day, however Karuman's planning process spanned one month with the guidance of her peers and the internet. Karuman's personal techniques and expertise as a digital photographer were tested while shooting a model submerged in a mixture of milk and water. The results were a series of photos expertly directed to give an abstract visual of Karuman's experiences as a multicultural teenager born and raised in America. The girl is immersed in a mysterious white liquid, surrounding her completely, revealing only the vibrant contrast of her blue eyes. This visual means to represent a struggle of blending in while simultaneously conforming to their environment.

---

## Aaron Kinslow

### Flax Fiber Emerging Technology Demonstrators

As the world's population increases, waste becomes an issue. The need to provide new types of materials is increasing. Current materials are petroleum based, and are non-biodegradable or non-recyclable. New materials are needed to be lightweight, strong, renewable, bio-based, recyclable, and assist local economies. A natural fiber such as flax is an ag-based crop that is currently grown and used for the oils in the flax seeds, and the fibers in the stalk can be used to make woven linens that are used in composites. When combined with a resin they can form many complex geometries of products. Testing is needed to find comparable properties between petroleum based and renewable materials. The hurdle with renewable materials is the difference in strengths compared to petroleum based products. To obtain comparable strengths, it is required to add plies (layers) or increase the thickness of weaves. In this study, a flax fiber random mat was formed into a mold with a bio-based resin and a vinyl ester resin to create a composite of a Spanish shingle tile. Through testing of specimens of a roofing shingle it was determined by an impact ballistic tester that upon increasing the thickness of the random mat flax fiber shingle comparable results were obtained that passed ASTM standards for a class 3 shingle rating. These results demonstrated that the flax fibers showed potential for use in a roofing shingle compared to current products. The added thickness increased weight, but achieved the required strength specifications compared to petroleum based products.

## **Jesstin Krech Ryan Bares**

Advanced Optical Diagnostics for  
Airflow Studies at NDSU

Surface modifications, such as dimples, are constantly being applied to airfoils and other devices to improve their aerodynamic performance. These modifications aim to improve aerodynamic performance, decrease weight, or decrease costs. Studying the flow over airfoils by measuring properties such as velocity and pressure is very important in modern research.

Particle Image Velocimetry (PIV) is a technique that uses high-power lasers to illuminate seed particles in flow volumes and high-speed cameras to record instantaneous flow images. Velocity is computed using imaging and data analysis software and flow patterns can be studied in three dimensions. Pressure/Temperature Sensitive Paint (PSP/TSP) is a technique in which pressure and temperature can be measured on surfaces. A paint is carefully sprayed on the test model surface and calibration, imaging, and data analysis software is used to calculate pressure and temperature.

During this NDSU EXPLORE campaign, PIV experiments successfully revealed velocity fields on smooth and dimpled airfoils. Their performance could be compared for various flow speed and angle of attack conditions. The TSP revealed significant characteristics on the surface such as flow separation and turbulence, especially inside the dimples. This indicated that the change in velocity within the dimple cavity creates a swirling motion that is transferred to the top of the airfoil.

The major implication of the study is the revelation that the flow is highly three-dimensional and a combination of PIV/PSP/TSP was critical for advancing understanding of surface modifications for flow pattern control.

---

## **Bethany Limke Julian Thrash III**

Electronic Signatures of  
Biomolecules for Sensing  
Applications

The accurate detection of biomarker molecules, from a sample of bodily fluids (e.g.: serum and blood), provides the critical information needed to devise optimized treatment strategies for control of elimination of diseases. Current methods used in diagnostics do not have the limit of detection, sensitivity and speed of detection needed to detect the critical stage of disease progression. To address this issue, first we are observing the interaction of biomolecules with electric fields and using the data to collect unique biomolecules' signatures for sensing applications. The interaction, due to the interference from the biomolecules, is being measured using the Fast Fourier Transform, where distortion of the applied electric field is calculated. In this study, we are focusing on miRNA, DNA, and protein molecules as they are sensitive biomarkers for many diseases. Second, we will utilize the new knowledge to develop a low cost, high speed, and label-free method for diagnostic applications that can be used for detecting the critical stage of disease progression.

**Levi Lucy**  
**R. F. Allen**  
**K. J. Aagaard**

Using Topological Data Analysis  
to Aid in the Effectiveness of  
Conservation Efforts

Large-scale conservation efforts require simplifying generalizations about focal systems for effective execution, but these generalizations often relate more to administrative zones than to critical habitats and associated species. Using data from the North American Breeding Bird Survey (BBS), we evaluate one such generalization as it relates to bird conservation: Bird Conservation Regions (BCRs). We use methods born from topological data analysis to detect community structures of birds in North America based solely on bird populations. We create a high-dimensional “profile space,” where each point in the space represents the profile of a BBS route, and use various metrics to quantify similarities between routes. We found that the Euclidean metric performs poorly, so we developed a profile metric which performs more effectively. We create a BBS-route network and split it into modules, where each module represents a region containing routes with highly similar profiles, and we compare this network to the existing BCRs. Our method produces a map of bird regions with appreciable overlap with BCRs; however, our method also revealed regions that were not well captured or described by the BCRs, suggesting that our method may provide improvements in defining these regions and represents a more efficient and biologically-relevant strategy for conservation efforts.

**Karissa Malm**  
**F. Keomanivong**  
**L. Reynolds**  
**K. Swanson**

Influence of Dexamethasone on  
Digestive Enzyme Activity in the  
Maternal and Fetal Pancreas in  
Beef Cattle

Understanding how physiological state influences pancreatic digestive enzymes and efficiency of nutrient use is important so that appropriate diets can be fed. Stress alters many physiological systems. Therefore, we used a model of dexamethasone (DEX; a synthetic glucocorticoid) infusion to pregnant cows to study how dexamethasone might influence pancreatic function and potentially feed efficiency. For this experiment, we predicted we would see an increase in pancreatic digestive enzymes in the cow and fetus treated before birth with DEX. Sixteen mature pregnant Angus cows (average  $671 \pm 17.0$  kg of BW) were randomly assigned to two treatment groups (9 cows per treatment): intramuscular injection of saline (4 ml) or DEX (40 mg in 4 ml of saline) on day 272 of gestation. The cows were slaughtered approximately 36 to 40 hours later and maternal and fetal pancreatic tissues were weighed and collected and analyzed for protein concentration and trypsin and amylase activity. Cows and fetuses treated with DEX tended to have heavier ( $p = 0.06$ ) pancreases than the cattle treated with saline. Trypsin activity in cows treated with DEX was greater ( $p = 0.05$ ) than in cows treated with saline. From our results, we can conclude that DEX tends to increase maternal and fetal bw and maternal trypsin activity. Therefore, stress responses mediated by corticosteroids may promote pancreatic growth and digestive enzyme production.

## Haley Marston Logan Clark

### CHRONOQUEST:

Our Adventures in a Team-based,  
Student-managed Authentic  
Geochronology Research Course

The ability to take secondary research efforts and combine it with primary research to add new knowledge to a topic of research is often not a skill that undergraduate students get to hone during their early studies. The focus on secondary research at the undergraduate level does help students develop the ability to synthesize knowledge from multiple sources and find new observations. This method does cause the student to miss some of the bigger picture aspects of scientific research. This undergraduate research effort is an exercise in adding primary research components to the student's curriculum.

The project began with a simple question: How does the small Minnesota town of Tintah tie into global climate change? The class was structured to spend the early portion researching the subject and discovering the answer to the question provided. Once the initial research was completed the next task was to determine how the students' research would fit into the larger picture of Lake Agassiz's role in the Younger Dryas event. The students would then create methods for selecting research areas, sample sites, and reaching out to land owners to gain access to locations for sampling. The students also were given opportunities to help process the samples in the OSL lab. Once the samples were processed and the data collected the students would analyze the results to determine the statistical viability of the data and prepare it for publication.

## Lauren McIntosh T.W. Bennett D.M. Streeter K.A. Stone J.W. Grier S.N. Stastny K.J. Hackney

Effects of L-arginine and Exercise  
on Heart Rate Variability

Heart Rate Variability (HRV) measures variation in time between the R waves on an electrocardiogram. HRV assesses the activity of the autonomic nervous system (ANS) using time domain calculations (mean RR, RMSSD, NN50, pNN50). A decrease in HRV, for example, is typically associated with elevated sympathetic nervous system activity. L-arginine is a precursor to nitric oxide, which aids in vasodilation and blood pressure regulation, therefore may also result in ANS modulation.

The purpose of this study was to examine possible effects of L-arginine on HRV before and after resistance exercise.

Thirty (15 male, 15 female) physically active, healthy participants (age  $20.4 \pm 1.8$  years, height  $176.9 \pm 10.2$  cm, body mass  $76.0 \pm 12.2$  kg) volunteered for the randomized, double-blind, cross-over study. Following a familiarization session, each subject returned to the lab for two subsequent trial sessions. Each subject arrived to the laboratory after 8 hours fasting. Baseline data were recorded and the participant consumed either placebo capsules or 3g of L-arginine. HRV measures were recorded 30 minutes post-consumption. Sixty minutes after consumption, the participant completed elbow flexion-extension resistance exercise. HRV measures were recorded immediately following exercise.

There were significant time effects for HRV when expressed as mean RR, RMSSD, NN50, and pNN50 (all p-values < 0.05). However, there was no significant difference between the L-arginine and placebo trials ( $P > 0.05$ )

Conclusion: L-arginine did not affect the ANS response to an acute bout of resistance exercise.

## Jared Melville

Performance Art on the Streets  
of London – Will We Watch,  
Not Interact?  
An Analysis of the Hornsleth  
Homeless Tracker

Human performance art provides a unique opportunity for artists to highlight a social issue through fostering engagement between the artist and the spectator. Today, the city of London continues to experience an excruciating homelessness problem. Provocateur Kristian von Hornsleth believes he has the answer London needs: the Hornsleth Homeless Tracker. Hornsleth is selling gold-plated portraits of London's homeless for £25,000, along with the rights to track them through an exclusive smartphone application any hour of any day. Using the Homeless Tracker as an artifact, the question must be asked: in what ways does the Hornsleth Homeless Tracker demonstrate how performance art can be used as a successful mode of communication for social justice issues?

Sophie Anne Oliver provides a model of how performance art can mobilize an audience into action in her 2010 article “Trauma, Bodies, and Performance Art: Towards an Embodied Ethics of Seeing,” located in the 24th volume of *Continuum: Journal of Media and Cultural Studies*. After using Oliver's model to identify three tenets efficacious performance art must exhibit and applying them to the Hornsleth Homeless Tracker, it was determined provocative performance art is effective at drawing attention to a social issue but fails to incite action if the artist becomes the center of attention. Two implications are uncovered from this response, describing how exploiting taboos is an effective tool for engagement and how narcissism kills the project.

---

## Amaniel Mrutu

An Exploration of Calculus  
Students' Beliefs about  
Mathematics

This study explores calculus students' beliefs about mathematics. The study's sample size was 437 students enrolled in Business Calculus or Calculus I at a land-grant university in the Midwestern United States. Student beliefs were measured using the Modified Indiana Mathematics Belief Scales (MIMBS), which are derived from the Indiana Mathematics Belief Scales and Fenema-Sherman Usefulness Scale. The purpose of this study is to consider how effectively the MIMBS measures calculus students' beliefs about mathematics and interpret the instrument's results relative to class and gender. Results from the MIMBS showed that students' beliefs about mathematics differ relative to class but not gender. Calculus I students demonstrated stronger beliefs to solve difficult problems, understand the importance of math concepts, and perceive the usefulness of math in everyday life.



**Mitch Musel**  
**Noah Thompson**

Designing Pervasive Energy  
Games to Impact Behavior

The goal of this ongoing project is to engage and educate the community in energy-efficiency activities. Over a two-year period, the project team has designed, tested, and implemented multiple engagement, outreach, and educational activities, including two impactful energy games: a digital online community game and a physical game for use in a K-12 environment. Based on data analysis, we have learned important lessons regarding targeted gaming activities, continual feedback systems, and components of serious pervasive energy games. We are now updating the online community game and the K-12 game to combine the strongest aspects of both.

---

**Emily Nelson**

The Effects of Short-Term Study  
Abroad

This ethnographic research project analyzes the effects of a short-term study abroad trip to Mexico during spring break of 2017. Central to the study is how cultural immersion, service learning, and historical intake impacts students' lives and world views. The project follows the students through two cities and one rural village in Mexico, and highlights the experiences the students found especially significant. Research findings will show how students were most effected by their time spent in the rural village, as well as their participation in the service learning component of the trip.



**Trent Olson**  
**J. Fischer**  
**L. Clark**  
**S. Gibbs Schnucker**  
**H. Marston**  
**K. Lepper**

CHRONOQUEST: Locating  
Sample Sites on the Poorly  
Expressed Tintah Shoreline of  
Lake Agassiz Using an Integrative  
Data Framework

A detailed chronology of the formation and life of Lake Agassiz has long been sought by Quaternary researchers. The chronology of Lake Agassiz is a key to understanding the end of the last ice age, beginning of the recent interglacial, and the Younger Dryas cooling event. Recent research involving Optical Stimulated Luminescence (OSL) has provided widely accepted dates for the shorelines of three of the four major beach-forming lake levels that Agassiz progressed through. The fourth major lake level, named the Tintah, lies in a crucial period that spans the Younger Dryas cooling event. Pinpointing the date of formation for this shoreline through OSL will fill a glaring void in the understanding of Lake Agassiz's chronology. Past researchers encountered difficulty in getting consistent samples from the Tintah shoreline, either because it was poorly expressed on the landscape or the sample didn't yield consistent data. Our plan to overcome these problems involved a multistage process involving several data sets to generate criteria to facilitate locating Tintah-aged shorelines. We used digitized shoreline data, web soil survey maps and satellite imagery to find several preliminary sites for our research.

**Jamal Omar**  
**R.S.R. Kalidhindi**  
**N.S. Ambhore**  
**S. Venkatachalem**

Role of KISS1/GPR54 Signaling  
in Airway Remodeling in Airway  
Smooth Muscle

Increased airway smooth muscle (ASM) cell mass and extra cellular matrix (ECM) changes result in significant airway remodeling contributing to loss of lung functionality in asthma. In addition to ECM proteins, ASM cells also produce a range of matrix metallo proteinases (MMP's) and tissue inhibitors of metallo proteinases (TIMP's) that are further modulated by cytokines. Recent studies on breast cancer tissue suggests that KISS1 receptor (KISS1R/ GPR54), which is involved in regulation of puberty in females, is involved in metastasis suppressing function, which down regulates proliferation when activated by kisspeptin (metastin). It acts by regulating the mTOR and TSC1/2 proteins in the cell. It is also evidenced that Estrogen Receptor  $\alpha$  (ER $\alpha$ ) agonists inhibit KISS1R/ GPR54 resulting in increased proliferation of cells in a study performed in breast cancer cells. Since asthma is more prominent in pre-pubescent and aging males, and in post-pubertal females, we suspect a possible crosstalk between estrogen and KISS1 signaling. In order to test the hypothesis, we profiled the expression of GPR54 and KISS1 in asthmatic and non-asthmatic primary human airway smooth muscle (ASM) cells (Passage<5). There is a significant decrease in the levels of GPR54 and KISS1 in asthmatic ASMC compared to non-asthmatic ASMC. Furthermore, inflammation induced with TNF- $\alpha$  (20ng/mL), IL-13 (50ng/mL) resulted in significant downregulation of KISS1, and GPR54 in both asthmatic and non-asthmatic cells compared to vehicle treated. MTT assay revealed significant reduction in proliferation of cells treated with metastin when compared to PDGF (2ng/mL). To conclude, KISS1 signaling portrays a possible role in remodeling of ASM cells in asthma.

**Michala Palmersheim**  
**B. Helm**  
**R. Royaute**  
**R. Mallinger**  
**G. Yocum**  
**J. Bowsher**

Sub Lethal Effects of  
Neonicotinoids on the Alfalfa  
Leafcutter Bee (*Megachile*  
*rotundata*)

Neonicotinoids are used in agriculture to manage pest-insect species, but many beneficial non-target species are also negatively affected by the broad application of these agrochemicals. For many beneficial insect species, lethal effects of neonicotinoids are well-documented; however much less is known about sub lethal exposure. The alfalfa leafcutter bee, *Megachile rotundata*, is a managed pollinator that constructs complex nests for its young. Nest construction requires a corresponding suite of behaviors that could be affected by neonicotinoid exposure—even when dosages are sufficiently low to avoid lethality. Our goal was to determine whether sub lethal neonicotinoid exposure alters nest construction behavior in adult female *M. rotundata*. First, the LD<sub>50</sub> of imidacloprid—a common neonicotinoid used in alfalfa and other *M. rotundata* pollinated crops—was determined by feeding adult bees different concentrations in 10% sucrose solutions. Lethal-effects were observed at doses of ~50ppm, lower than previously determined through topical application and fell within potential field-relevant exposure levels. Nesting success was measured by releasing adult females into field cages after exposure to 1ppm imidacloprid in sucrose solution (treatment) or sucrose solution (control) for 24 hours. Females that were treated with imidacloprid did not show signs of completed nests. An acetylcholinesterase assay was performed to measure the physiological duration of imidacloprid exposure. However, we observed no upregulation of acetylcholinesterase activity following exposure to imidacloprid. Thus, behavioral effects of sub lethal doses were present without enzymatic upregulation of acetylcholinesterase. In conclusion, these results suggest a higher sensitivity to neonicotinoids than previously suspected, including substantial consequences on nest-building behavior.

**Collin Pirner**  
**S. Horne**  
**P. Bergholz**  
**B. Prüb**

Motility Characterization  
of *Escherichia coli* Isolated  
From Soil

*Escherichia coli* is continuously dispersed into diverse non-host environments and this process may lead to the selection for biodiversity in its genome. To test theories about the role of the soil environment in *E. coli* biodiversity, we used a collection of 322 *E. coli* from phylogroup D, the most genetically diverse of *E. coli* subspecies. We asked the question, “What is the diversity of motility phenotypes in these isolates?”

Insertions or deletions in the *flhD* operon can have a dramatic effect on *E. coli* motility. The 322 environmental *Escherichia coli* isolates were assessed qualitatively for motility on swim plates at 34°C. They were categorized into four groups; non-motile, slightly motile, motile, and very motile. Of the 322 isolates, 15 were non-motile, 72 slightly motile, 75 motile and 160 were very motile. PCR was used to screen non-motile and very motile isolates for insertion or deletions in the *flhD* operon. No insertions were found in the non-motile isolates. These were then for tested mutations in the *flhD* operon by transformation with a plasmid expressing *FlhD/FlhC*. Motility was restored in 4 of 15 isolates. The swim rate of the very motile isolates was quantitatively evaluated on swim plates and compared against a motile laboratory *E. coli* strain. The very motile isolates swam an average of 5 mm faster per hour than the control. These very motile isolates are currently being screened for *flhD* operon insertions by PCR.

## Erin Richards S. Haring

Mec1- Independent  
Phosphorylation of Rpa2  
N-terminus in the DNA  
Damage Response

Replication Protein A (RPA) is an essential heterotrimeric single-stranded DNA-binding protein complex conserved from yeast to humans and plays crucial roles during DNA replication, recombination, and repair. In *Saccharomyces cerevisiae*, RPA has been demonstrated to be phosphorylated at serine 122 (S122) of the second subunit (Rpa2) in response to DNA damage by the checkpoint kinase Mec1. With this said, current evidence from the Haring Lab demonstrates no detectable physiological role of Rpa2-S122 phosphorylation. Through Western blot analysis of wild-type (WT) cells and rpa2-s122 phospho-mutants, this study confirms additional phosphorylation of Rpa2 in response to two DNA-damaging agents. Analysis of Rpa2 N-terminal (NT) phospho-mutants strongly suggests the serine/threonine-rich NT region of Rpa2. Western blot analysis of rpa2-s122 and rpa2-NT phospho-mutants indicates that the timing of phosphorylation at these two sites/regions differ, implying both an early role and a late role for Rpa2 phosphorylation in the DNA damage response. Moreover, this N-terminal Rpa2 phosphorylation appears to be both Mec1- and Tel1-independent. Additional evidence infers that the phosphorylated-state of Rpa2-NT, not Rpa2-S122, regulates premature exit from a DNA damage-dependent checkpoint in the face of a single, irreparable DSB. This aberrant checkpoint exit correlates well with the late phosphorylation observed in Rpa2 NT mutants. Understanding the molecular mechanisms by which cells accumulate mutations, as a result of premature checkpoint exit, could lead to novel treatment options aimed at preventing cellular diseases, such as cancer.

## Alyssa Roberts

DFT Insights into the Thiol/  
Thiolate Conversion on the  
Surface of CdS Quantum Dots

Using computations based on Density Functional theory (DFT) at the PBE1PBE functional with mixed basis set LANL2DZ (Cd and S) and 6-31g\*(H, C and N) level, we investigated the effect of ligand attachment to the surface of a CdS quantum dot (QD) of 1.5 nm in diameter. We focused the effect of solvent polarity (propylamine –  $\epsilon=4.99$  vs. acetonitrile –  $\epsilon=35.69$ ) on the ligand-QD interactions, mainly, the conversion of thiol to thiolate/H. This conversion is enhanced in nonpolar solvents such as propylamine. The 0K energies of QDs passivated by a single thiol or thiolate/H and 20 methylamines, indicate the conversion should be thermodynamics favorable. However, the initial thiol structures are sufficiently stabilized by the methylamine preventing the conversion. When thiol passivated QDs are investigated some thiols convert to thiolate/H which slightly effects the electronic properties but the thiolate/H QDs are dominated by thiolate/H. The thiolate/H introduce electronic states which are highly localized on the thiolate, this localization would indicate that the QDs would not be emissive. This is a potential problem for display application. However, changing the solvent to acetonitrile which is polar could reduce the conversion from thiol to thiolate/H. Our future work will investigate the excited state properties in propylamine and then change the solvents and find the effects of acetonitrile on the ground and excited state of CdS QDs.

## Kimberly Schaper

### Causes of *E. coli* in Fargo Water Basins

Water quality is often problematic in storm water systems. The Fargo Project was developed to convert single-use storm water detention basins into a multiple use facilities. A study on water quality in the basins was initiated to assess what uses could be considered safe in the basin. In addition, inputs and outputs of other pollution were studied to see if the basin can act to moderate the pollution levels. Previous research has found that the level of pet and geese waste is one of the major contributors to water quality problems, especially for *E. coli* and phosphorus. A survey of pet and geese waste was initiated in the catchment areas of three basins part of the Fargo Project study area; Fish Eye, Scheels, and Rabanus. Public walking areas where people would commonly walk their pets and where waste could enter the storm water system were surveyed for pet waste estimating the density of pet waste pure unit area. In addition, areas where geese would congregate were surveyed for geese waste. Preliminary analysis found that pet waste was concentrated in small areas of the basins. Geese waste was prevalent in several basins. Plans for the data are for it to be part of the analysis of water quality to determine its contribution to water quality problems.

---

## Regina Schimek

### Intra-reliability of ImageJ Processing of Ultrasound-derived Cross-sectional Area: Upper-leg Subcutaneous Fat

The purpose of this study was to evaluate the reliability of ultrasound-derived cross-sectional area analysis of thigh subcutaneous fat (TSF) using ImageJ and to see if there was a positive correlation between TSF and echo intensity (EI) of the rectus femoris.

Ultrasonic images were obtained on a Phillips HD11 XE ultrasound system (Bothell, WA) using B-mode. Images were assessed by measuring the distance between TSF and rectus femoris. Each image was measured using ImageJ by two undergraduate research assistants. Intraclass correlation coefficients (ICC) were used to examine the reliability between two analyzers, and were calculated with SPSS statistical package version 24 (SPSS Inc., Chicago, IL). The ICC estimate was calculated based on an absolute agreement, two-way mixed effects model. Internal consistency among the raters was measured using Cronbach's alpha. Pearson correlation coefficient (PCC) measured the linear dependence of TSF and rectus femoris EI.

The results showed that the reliability of measuring TSF using traditional ultrasound images (TU) was high, with an ICC of 0.775. A Cronbach's alpha score of 0.871 shows good internal consistency between the two analyzers. The PCC between TSF and EI of the rectus femoris was 0.323, demonstrating a weak, but positive linear relationship ( $p = 0.027$ ).

Conclusions: The results show that traditional ultrasound images can be used to reliably measure TSF of the rectus femoris. We can now use the same TU method for creating health standards of muscle quality based on thickness of TSF in the rectus femoris. The results also showed us that there is a positive, linear correlation between TSF and EI, but it is not a very strong correlation.

## Alexandra Sherrard

### Physical Activity Reduces Subcutaneous Adipose Tissue in Older Adults

Previous studies suggest a relationship between increased regional subcutaneous adipose tissue (SAT) and chronic diseases. Increased SAT has been observed in older adults; however, the role of concurrent exercise in the reduction of SAT is not well understood.

The purpose of this study was to evaluate SAT of the thigh (TAT) and calf (CAT) among younger and older individuals with sedentary and active lifestyles. Serial axial plane MRI scans of the thigh and calf were obtained from 49 sedentary individuals (n = 25, age = 26.3 ± 4.7 years; n = 24, age = 57.9 ± 4.5 years) and 49 active individuals (n = 25, age = 23.0 ± 3.1 years; n = 24, age = 57.3 ± 4.0 years). ANOVA was used to determine the differences in TAT and CAT among the four groups of adults. A value of  $p \leq 0.05$  was used to determine statistical significance.

The results showed that there were significant differences in TAT and CAT between the Older Sedentary and Younger Active, respectively (TAT: 35.67 ± 13.46 vs. 26.55 ± 9.50,  $p = 0.032$ ; CAT: 24.91 ± 8.97 vs. 19.09 ± 6.46,  $p = 0.046$ ). A significant difference was also found between the Older Sedentary and Older Active CAT (24.91 ± 8.97 vs. 18.6908 ± 7.02462,  $p = 0.030$ ).

Conclusions: These results show that age plays a significant role in adiposity and that concurrent training may be used to reduce SAT in older adults. Future studies examining potential differences in people of various ages and activity levels would be beneficial.

---

## David Syverson

### Cyanogenic Glycosides in Flaxseed

Flax seeds have compounds in them called cyanogenic glycosides. Cyanogenic glycosides can cause a cyanide toxicity if too much of the substance is consumed at time. To reduce the potential for cyanide toxicity in flax, heat treatments can be performed to lower the cyanogenic glycoside content. To test the treated flax, an extraction of the compounds was done. The extraction is done using 70% methanol solution in a sonicating water bath before being centrifuged. After extractions are completed, testing is continued using High Performance Liquid Chromatography to determine which components are still present in the flax. I expect to see the heat treatments reduce the overall cyanogenic glycosides in the flax seed. This would result in the ability for consumers to eat larger quantities of flax by reducing the potential for cyanide poisoning.

**Brittany Twiss**  
**Madelyn Pennings**  
**M. Stewart**  
**A. Brunt**

### Evaluation of Fruit and Vegetable Intake of Preschoolers

The objective of this study is to increase fruit and vegetable intake among preschool children.

The Center for Disease Control and Prevention reports that many preschool children are overweight and do not have daily consumption of fruit and vegetables. Moreover, young children learn by touching, tasting and doing. The Social Cognitive Theory (SCT) was used to develop the intervention, materials and evaluation methods. It was hypothesized that preschoolers were more readily influenced by their peers and likely to consume a larger quantity of fruits and vegetables if their friends do so as well.

The target audience of this study is preschool children aged 3, 4 and 5 years, specifically at the NDSU Child Development Lab. For assessment, 20 preschoolers were observed eating their meals before the intervention and parents filled out a brief survey. The SCT was then utilized to develop the intervention: a fruit and vegetable identification activity, bingo game with fruits and vegetables, and activity that included making and tasting guacamole. Learning methods included visual, hands-on and interactive.

The children influenced each other to participate in eating more fruits and vegetables during each part of the intervention. According to the post-intervention observation, fruit and vegetable consumption increased to over 80 percent. Preschool students were also observed during meal periods, post-intervention, discussing with peers how eating their fruits and vegetables help them grow big and strong.

Conclusions and Implications: The intervention successfully increased the preschool students' fruit and vegetable intake.

---

**Donald Veverka**

### Fetid Marigold Odor Survey

This research is a germination study on fetid marigold (*Dyssodia papposa*). Fetid marigold is a plant that is commonly seen in prairie dog towns and other disturbed areas. The plant is known for its distinct odor that deters wildlife or cattle from eating it. The odor makes the plant a good candidate as a cover crop for native plantings deterring cattle from grazing young native plants. A greenhouse experiment was conducted with field collected seed to establish germination rates. The results showed that fetid marigold was fast establishing needing only seven days from planting to germination with a high percentage of seeds germinated. Once the plants were grown students from different backgrounds were brought to the greenhouse to rank the odor. The survey showed that the greenhouse plants have the same distinctive odor similar to the field situation. The results show that field collected fetid marigold seed are fast establishing with a high germination rate. Thus, this plant could be considered as way to reduce grazing on native plantings without fencing or taking grazers off the land.

## **Donald Veverka**

### Fargo Project Aquatic Survey

This research project is an aquatic survey on a newly restored stream located in the Fargo Project area. The Fargo Project took a detention basin and naturalized it by removing the cement lined channel and restoring the stream. The surveys were done to establish baseline knowledge on what kinds of macroinvertebrate species are living in the newly restored stream. For the survey we collected six samples from both the faster and slower moving portions of the restored stream. The rapid flowing water comes out of an outfall pipe from the West Acres Mall, and the slower flowing water comes from a business zoned area with a wet detention basin. After collecting the samples using D-frame dip nets following Minnesota Pollution Control Agency protocols we preserved the samples in alcohol. In the lab we identified the different macroinvertebrates to the lowest genera with the help of a microscope. Once the macroinvertebrates were identified and counted, we then researched what they indicate about the water quality of the stream. One of the primary indicators for good quality water is available oxygen. We discovered that the macroinvertebrate species that we collected indicate good water quality for the stream, because the macroinvertebrates living there require high oxygen levels to survive. Thus, the newly restored streams even when isolated in a detention basin within the city did have macroinvertebrates indicative of good water quality.

---

## **Sierra Walker D. Scott J. C. Wilkinson**

### AIF: A Universal Regulator on Cell Redox Signaling

Apoptosis-inducing factor (AIF) is a mitochondrial oxidoreductase. Apart from its cell death roles, AIF has the capacity to generate superoxides through NADH-oxidase activity. However, redox control mechanisms are not well understood. AIF-mediated redox regulation is the focus of this research. A novel role for AIF as an amplifier of both mitochondrial and cytosolic reactive oxygen species (ROS) that activate the mitogen-activated protein kinases c-Jun N-terminal kinase 1 (JNK1) and p38 surfaced. The NADH-oxidase activity of AIF is a driver of pro-oxidant signaling pathways, and its enzymatic activity is a mitochondrial sensor and effector of both cellular redox and metabolic state with important implications for cellular homeostasis and human disease.

**Sierra Walker**  
**B. I. Fedeles**  
**J. M. Essigmann**

Mutagenicity of DNA Lesion  
Sequences Containing Oxidized  
& Chlorinated Products

DNA encodes important information for life, and is, unfortunately, susceptible to damage from biochemical stress. When damaged DNA is unrepaired and replicated, there is the possibility for an error in the coding process. The resulting mutations are then associated risk factors for cancer.

Prolonged inflammation engenders elevated levels of caustic molecules like hypochlorous acid and reactive oxygen species. These may cause the oxidation or chlorination of biomolecules. Key examples of functional biomarkers that contribute to cancer are 8-oxoGuanine and 5-ChloroCytosine. A specific repair pathway for this lesion exists, though efficiency depends on sequence context.

This project aims to build understanding of mutagenic frequencies when lesions have the opportunity to interact. The mutagenic properties of both key lesions have been demonstrated in isolated conditions, yet inflamed tissues can accumulate each type simultaneously. Our hypothesis is replication across the 8-oxoG lesion will yield more mutations in the presence of a second lesion (5-chloroC) exactly one position upstream.

Analysis will consist of reviewing the mutation frequency in progeny phage of infected bacteria. Constructs containing lesion sequences and an identifying barcode will be cloned into strains of bacteria that are either proficient or deficient in components of the 8-oxoG repair pathway. Then, samples will be pooled together and mutagenicity will be quantified.

Inflammation is an established risk factor for cancer. Any time a mutation is present, a patient runs the risk of disease. A better understanding of the mechanisms behind DNA repair and under what conditions they fail may lead to better preventative care.

**Yuefan Wang**  
**Junlong Xiang**

An Innovative Flat Plate Collector  
Design for Heat and Cold  
Collection

A Flat Plate Solar Collector (FPSC) is a commonly used device to harvest solar energy. However, the application of a conventional unglazed FPSC for heating purposes is limited to low temperature differentials due to the absence of a glass cover and insulation materials. Moreover, it is inefficient in cold collection since its structure and materials are still subject to its original design concept. Therefore, in this proposed collector, a double-pane "window" will be used on top of a FPSC to replace the conventional single-pane glass cover, which allows water or other liquid flowing in the space between the two glazing panes to lose its heat through both long-wave radiation and convection. This new collector will not only retain the functionality of a conventional glazed FPSC for heat collection, but also have an additional ability for cold collection with enhanced efficiency and cost-effectiveness compared with unglazed collectors. The expected research output mainly includes the successful development of a fully functional lab-scale prototype of the proposed collector for the purposes of heat and cold collection in a real environment where this collector is exposed to solar irradiation and cold night sky.



## Braden Weight S. Kilina

### Mixing of Covalent and Noncovalent Functionalization of Single-Walled Carbon Nanotubes

Carbon nanotubes (CNT) play an important role in nanotechnology, including electronics, chemical sensors, and solar cells. Their electronic and optical properties depend on the diameter and chirality of the nanotube. Covalent functionalization is another way to tune the electronic properties. The composition of these groups has been proven to affect the localization of the electron density. We hypothesize that the geometric placement of these groups, relative to the tube axis, is equally important. Our goal is to be able to understand and predict relative band gap values and emission energies for any given functionalization. It is reasonable to expect that non-covalent functionalization by conjugated polymers should also affect the interaction between the CNT and covalently-attached groups resulting in their stronger binding in proximity of the polymer. We computationally study non-covalent functionalization of the covalently-functionalized CNT by 9,9-dialkylfluorenyl-2,7-diyl and 9,9-dialkylfluorenyl-2,7-diyl bipyridine polymers. Calculations have shown correlations between the polymers' alkyl side groups and their wrapping morphology to pristine CNTs for the purposes of chirality separation. We extend this approach to covalently-functionalized CNTs to obtain a better grasp of the CNT-polymer interactions and their impact on the covalent functionalization. Our goal is to be able to understand and predict band gap values and emission energies for any given functionalization and geometric positioning thereof. This will be achieved in three steps: (I) obtaining optimized ground-state structures through molecular-mechanics simulations, (II) using density functional theory (DFT) calculations to obtain electronic orbitals and density of states, (III) utilizing linear-response time-dependent DFT to obtain the energy and intensity of optical transitions, which will provide further understanding of the effects of covalent functionalization on absorption and emission of CNTs.

## Braden Weight A. Denton

### Swelling and Structural Properties of Polymer Microgels: Computer Simulations of a Coarse-Grained Model

Microgels are microscopic particles composed of crosslinked polymer networks, which swell in a solvent. Due to their soft, compressible nature, microgels have many applications, including drug delivery and biochemical sensors. Their compressibility can be tuned by environmental factors such as pH, temperature, crowding, and ionic strength. The swelling of microgels is directly dependent on the concentration of tetravalent crosslinkers, which aid in mechanical stability. Microgels are distinguished by their crosslinks distribution, which can vary from isotropic to core-shell structure. Starting our exploration at the level of random crosslink distribution, we model the swelling and compression of a spherical microgel via molecular dynamics simulations to investigate the response of equilibrium radius to external conditions. We seek to provide a benchmark to the Flory-Rehner theory of polymer networks, which relates the swelling of a polymer gel to the entropy of mixing between the solvent and polymer. Using a molecular model in which polymers are represented as chains of coarse-grained beads, we perform simulations at constant temperature until equilibrium has been reached. The beads interact via van der Waals interatomic potentials characterized by the dielectric medium, as well as parameterized bonded potentials. In the case of spherical microgels, we can directly obtain the swollen radius and compare it to the dry radius when no solvent is present. Although we initially consider microgels composed of uncharged polymers, our approach can be extended to ionic microgels. An additional extension could be to model diffusivity of solutes from within the microgel in swollen and de-swollen states.

## **Sarah Whims**

### Analysis of Moisture Content in Natural Flax Fibers

With the rise of green energy in industry, natural fibers are beginning to be used as a substitute for fiberglass, carbon fiber, and other fibers alike for the applications of composite materials. Due to a low amount of data regarding the characteristics of such natural fibers, this study was aimed to analyze the influence on the rate of drying natural fibers when conducting moisture testing to provide guidelines for a future ASTM standard. Within this experiment, measurements of initial moisture content were taken along with interval weights of a fully saturated natural flax fiber mat exposed to 55°C and 80°C for observation of desorption, followed with a final measurement of moisture content for comparison. With the two temperatures, the results showed that it was exceptionally noticeable that the fibers exposed to the higher temperature had a more rapid drying rate.

## **Abbey Wohlers J. Droel R. Hasan A. Brooks**

### Development of a Bone Void Filling Putty to Release an Antibiotic Cocktail for Total Joint-Associated Infection

Total joint replacement (TJR) is a routinely performed surgical procedure. Over a million total knee and hip replacement (TKR and THR) surgeries were done in 2010, and the number is increasing each year. Moreover, roughly 7-16% of the TJR patients will require a revision surgery to replace failing hardware, which increases the infection rate from as high as 4% up to 8-15%. These infections pose a significant economic and social burden. To prophylactically treat patients to prevent orthopedic infection and to support bone growth, development of an antibiotic-eluting bone void filler (ABVF) with adequate pharmacokinetics should be explored. In the current study, an ABVF putty was formulated using polymers (PLGA, PEG, PCL) and a tri-calcium phosphate and hyaluronic acid substrate (Pro-osteon). A combination of rifampicin and vancomycin were incorporated into the putty. Rifampicin is shown to have good activity against bacterial biofilm and vancomycin is a treatment of choice for *Staphylococcus aureus*, the most frequent causative organism for TJR-associated infection. After releasing the drugs from ABVF for five weeks, the bioactivity of release drug against *Staphylococcus aureus* was assessed via disc diffusion method. Strong zero order release kinetics were observed through the first week switching to first order release through the remaining five weeks. The ABVF showed good bacterial killing up to five weeks.

## Connor Yaggie

### Impact of Drainage Water Management on Soil and Water Quality and Crop Production

Assisting Dr. Xinhua Jia, I have been engaged in an ongoing research project on the impact of drainage water management on soil and water quality and crop production, and specifically, on the effects of drainage tile near Fairmount, ND. We visit the field every two weeks to collect water samples, view the electrical conductivity, measure the water table height, and collect soil moisture data. I then process these data by removing any mistakes made by our sensors and putting them into graphs. I try to examine the data to make sure it is accurate and consistent with the other sensors and rainfall totals.

This project is extremely valuable to the farmers of the Red River Valley, as farmers begin tiling more acres and considering not only drainage, but also sub-irrigation. It is important to know not only how much water you're taking out and putting back in, but also what salts and important nutrients are coming out. It is also important for soil structure and crop uptake, so farmers can prove they are properly managing drainage water and not putting contaminants into the water and losing important crop nutrients from their fields. Losing certain nutrients hurts yield or can cost lots of money to replace.

At the end of each year, we examine a yield map from the farmer and compare it to our research to determine why some parts of the field yielded better than others. We share this information with the farmer to help them achieve the best yields possible and, thus, the largest profit.

## Alexander Zeller

### Thermodynamic Analysis of a Manufacturing Facility

According to the U.S. Energy Administration, over 13,500,000 Tera Joules (TJ) were consumed by the industrial sector in 2016. A large amount of this energy is eventually exhausted into the atmosphere as waste heat. Thus, energy expenses and environmental impacts could be greatly reduced through the collection and reuse of this waste heat. Design of effective waste heat capture, storage, and reuse systems requires detailed knowledge of waste heat sources and temperatures. However, there are a limited number of such analyses for many industries. The present work is a thermodynamic study which identifies and quantifies sources of waste heat and the potential heating load reduction for a contract manufacturing facility in North Dakota. Additionally, the potential for the waste heat to reduce the heating load is determined. A plant-wide survey identified the potential sources of waste heat as boiler, deaerator, condenser, polypropylene driers, compressed air dryer, plant vacuums, and electroplating air handler. The energy and exergy rejected per month was calculated from measured temperatures, flow rates, and duty cycles of these components. The heating load for the facility was determined from the natural gas consumption and boiler efficiency. The analysis determined that the boiler, the plant vacuums, and the polypropylene driers comprise 94% of the total energy rejected. The total annual waste heat is 9.4 TJ of energy which represents 0.9 TJ of exergy. The significantly smaller amount of exergy reveals the low quality of energy rejected. However, the energy is of sufficient quality to provide space heating. The annual energy required to heat the facility is 8.5 TJ. Therefore, the waste heat could provide the heating requirements.

