

# North Dakota Academy of Science

Proceedings of the 111<sup>th</sup> Annual Meeting

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# PROCEEDINGS OF THE NORTH DAKOTA ACADEMY OF SCIENCE

Volume 73

March 2019

NORTH DAKOTA ACADEMY OF SCIENCE  
*(Official State Academy; Founded: December 1908)*

2018-2019

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111th Annual Meeting

March 8, 2019

Grand Forks, North Dakota

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## EDITOR'S NOTES

Welcome to the *Proceedings of the North Dakota Academy of Sciences* for the 111th Annual Meeting of the Academy.

Within the *Proceedings*, you will find information pertaining to the history of the Academy, membership and participation, Academy business, how to receive communications from the Academy, the list of presenters at the Annual Meeting, and of course, abstracts pertaining to each presentation. This communication will be available [online](#) and will be [archived](#) following the Annual Meeting.

I would like to take this opportunity, on behalf of the Academy, to acknowledge current and *emeritus* members of the Academy who continue to support the mission of the North Dakota Academy of Science through their special gifts and participation in Academy business.

On behalf of the Academy, I also wish to express gratitude to the presenters at this meeting and their mentors who have devoted the time, effort, and often finances to provide students with the opportunity to experience a conference where they are exposed to a diverse range of research areas and to provide guidance for students as they develop skills towards becoming the next generation of scientists.

Finally, I would like to thank those who have volunteered their time to help make this meeting possible and allow it to run efficiently. This includes those who have organized the spaces, arranged for accommodations, ensured that finances were in order, and have volunteered as judges and/or session chairs. Voluntary participation in these endeavors are what ensure that the Academy can continue its mission "to promote and conduct scientific research and to disseminate scientific knowledge", not only in the state of North Dakota, but also regionally, nationally, and globally.

Sincerely,



Stuart J. Haring  
Secretary, North Dakota Academy of Science

## NDAS LISTSERV

In order to promote better communication between Academy members, an NDUS LISTSERV (NDUS-NDACADSCI@listserv.nodak.edu) was established in 2015. Anyone wishing to receive communications from the North Dakota Academy of Science, including information on future Annual Meetings, may subscribe.

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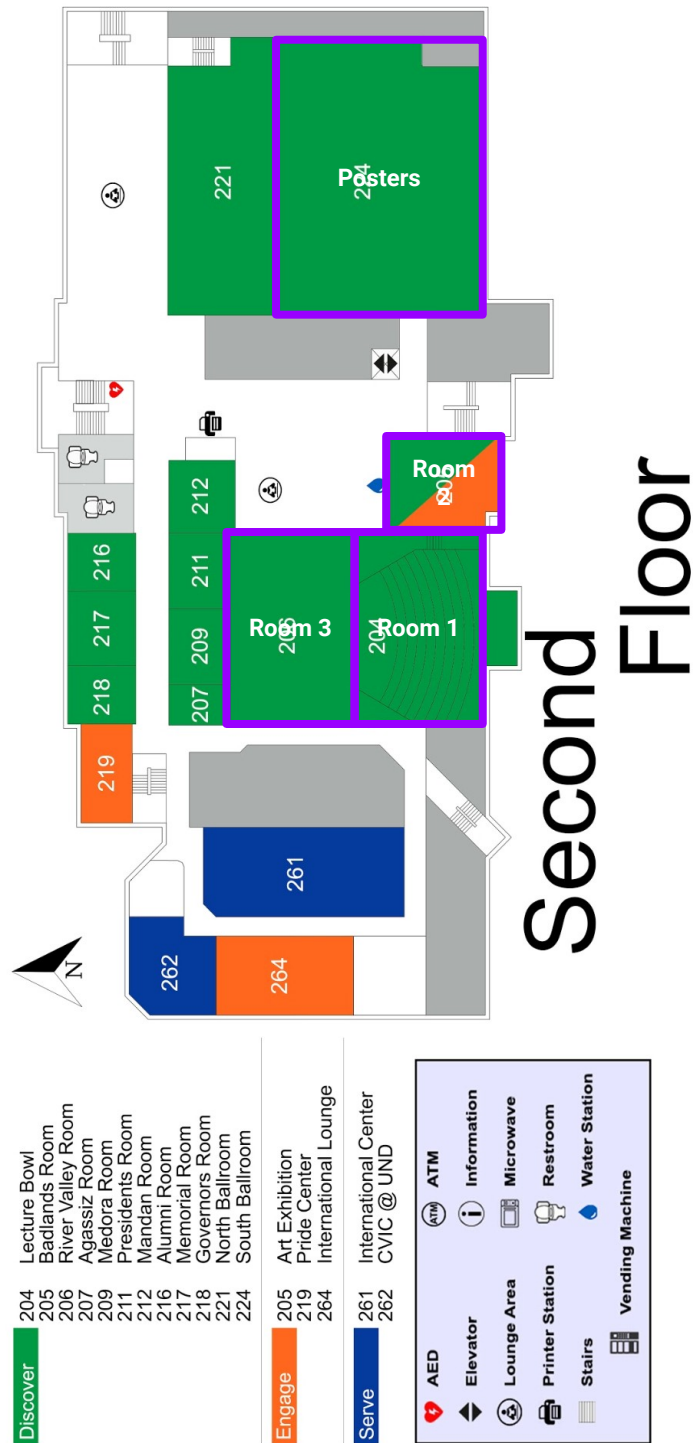
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MEMORIAL UNION ROOM MAP



## SCHEDULE

All events will be held in the Union on the campus of the University of North Dakota.

Friday, March 8			
Time	Room 1: Lecture Bowl	Room 2: Badlands	Room 3: River Valley
8:30 AM	REGISTRATION AND BREAKFAST		
9:00 AM	<b>WELCOME AND OPENING REMARKS</b> in the <i>Lecture Bowl</i> <i>NDAS President Darland</i>		
9:20 AM	<a href="#">Mallula</a> (G)	<a href="#">Liu</a> (G)	<a href="#">Burnett</a> (U)
9:40 AM	<a href="#">Tahmasebi Nasab</a> (G)	<a href="#">Nayakasinghe</a> (G)	<a href="#">Mohammad</a> (G)
10:00 AM	<a href="#">Gupta</a> (F)	<a href="#">Wu</a> (F)	<a href="#">Kim</a> (F)
10:20 AM	BREAK		
10:40 AM	<a href="#">Skinner</a> (U)	<a href="#">Ghimire</a> (U)	<a href="#">Vollmer</a> (G)
11:00 AM	<a href="#">Herath</a> (G)	<a href="#">Singh</a> (G)	<a href="#">Roy</a> (G)
11:20 AM	<a href="#">Amjaour</a> (G)	<a href="#">Ali</a> (G)	<a href="#">Rahman</a> (F)
11:40 AM	LUNCH		
12:40 PM	<a href="#">Dailey</a> (G)	<a href="#">Lakey</a> (G)	<a href="#">Kalbach</a> (G)
1:00 PM	<a href="#">Ghosh Dastidar</a> (G)	<a href="#">Thompson</a> (G)	<a href="#">Sun</a> (G)
1:20 PM	<a href="#">Biggane</a> (G)	<a href="#">Smith</a> (G)	<a href="#">Collette</a> (F)
1:40 PM	BREAK		
2:00 PM	<a href="#">Mulinti</a> (G)	<a href="#">Germundson</a> (G)	
2:20 PM	<a href="#">Hasan</a> (G)	<a href="#">Bhattacharya</a> (G)	
2:40 PM	<a href="#">Rudraraju</a> (G)	<a href="#">Haring</a> (F)	
3:00 PM	<b>COMPETITION JUDGING</b> in the <i>River Valley Room</i> <i>All faculty members are encouraged to participate.</i>		
3:00 PM	<b>POSTER SESSION</b> in the <i>South Ballroom</i>		
4:30 PM	<b>BUSINESS MEETING</b> in the <i>Lecture Bowl</i> <i>All Academy members are encouraged to attend.</i>		
5:30 PM	DINNER		
6:30 PM	<b>KEYNOTE SPEAKER</b> <a href="#">Dr. Jeff Gross</a> <i>Professor of Ophthalmology, University of Pittsburgh School of Medicine</i> <i>"Vision for the Future: Modeling Eye Disease with Zebrafish"</i>		
7:30 PM	<b>AWARDS AND CLOSING REMARKS</b>		

## PRESENTERS AND PRESENTATION TITLES

<b>Room 1: Lecture Bowl</b>		
<b>Morning Session 1</b>		
<b>Session Chair: Zhao</b>		
9:20 AM	<a href="#">Mallula</a> (G)	EFFECTS OF NON-CONVENTIONAL GAS AND OIL PRODUCTION ACTIVITIES ON FINE PARTICLES & GROUND LEVEL OZONE
9:40 AM	<a href="#">Tahmasebi Nasab</a> (G)	A NEW MACRO-SCALE HYDROLOGIC MODEL FOR DEPRESSION-DOMINATED COLD CLIMATE REGIONS
10:00 AM	<a href="#">Gupta</a> (F)	DESIGN OF POROUS CARBONACEOUS FOAM FROM LIGNIN
10:20 AM	<i>BREAK</i>	
<b>Morning Session 4</b>		
<b>Session Chair: Wu</b>		
10:40 AM	<a href="#">Skinner</a> (U)	NOVEL METHOD FOR THE SYNTHESIS OF DIBENZYL METHYLAMINES VIA THE LEUCKART REACTION
11:00 AM	<a href="#">Herath</a> (G)	DESIGNING RU CATALYSTS FOR SELECTIVE C-H BOND OXIDATION REACTIONS
11:20 AM	<a href="#">Amjaour</a> (G)	SCALABLE PREPARATION A CIS-CYCLOBUTANE-1,2-DICARBOXYLIC ACID FROM $\beta$ - TRANS-CINNAMIC ACID

<b>Room 2: Badlands</b>		
<b>Morning Session 2</b>		
<b>Session Chair: Schmidt</b>		
9:20 AM	<a href="#">Liu</a> (G)	GRAPHENE OXIDE-BASED ASSAY FOR SENSITIVE FLUORESCENCE DETECTION OF DNA EXONUCLEASE ACTIVITY
9:40 AM	<a href="#">Nayakasinghe</a> (G)	POLARITY ENHANCEMENT OF SILICATENE STRUCTURES BY DOPING WITH ALUMINUM: A 2D ANALOG FOR ZEOLITES
10:00 AM	<a href="#">Wu</a> (F)	REDUCE GRAPHENE OXIDE/AG NANOCOMPOSITE TO ENHANCE SYNERGETIC ANTIBACTERIAL CAPACITY
10:20 AM	<i>BREAK</i>	
<b>Morning Session 5</b>		
<b>Session Chair: Kim</b>		
10:40 AM	<a href="#">Ghimire</a> (U)	SENSITIZING AML CELLS TO DIFFERENTIATE WITH ATRA
11:00 AM	<a href="#">Singh</a> (G)	GSTP1 REGULATES PANCREATIC CANCER GROWTH THROUGH ITS INVOLVEMENT IN OXIDATIVE STRESS PATHWAYS
11:20 AM	<a href="#">Ali</a> (G)	GRAVIN/AKAP12 PLAYS A ROLE IN ENDOTHELIAL CELL MIGRATION AND ANGIOGENIC SPROUTING

<b>Room 3: River Valley</b>		
<b>Morning Session 3</b>		
<b>Session Chair: Keller</b>		
9:20 AM	<a href="#">Burnett</a> (U)	DELETION OF AUXIN BINDING PROTEIN-1 INCREASES STRATIFICATION AND DECREASES LATERAL ROOT INITIATION
9:40 AM	<a href="#">Mohammad</a> (G)	GENOME-SCALE CRISPR-CAS9 SCREENING TO IDENTIFY CYTOTOXIC MECHANISMS OF PIPERLONGUMINE IN PDAC CELL
10:00 AM	<a href="#">Kim</a> (F)	PERIVASCULAR "RE-INVESTMENT" :NEW CONCEPT OF VASCULAR NORMALIZATION
10:20 AM	<i>BREAK</i>	
<b>Morning Session 6</b>		
<b>Session Chair: Munski</b>		
10:40 AM	<a href="#">Vollmer</a> (G)	EFFECT OF SIMULATED HAIL DAMAGE ON YIELD LOSSES OF CANOLA
11:00 AM	<a href="#">Roy</a> (G)	ASSOCIATION MAPPING FOR SCLEROTINIA STEM ROT RESISTANCE IN A WORLD COLLECTION OF BRASSICA NAPUS L.
11:20 AM	<a href="#">Rahman</a> (F)	GENETIC AND GENOMIC DISSECTION OF CANOLA ROOT ARCHITECTURE

<b>Room 1: Lecture Bowl</b>		
<b>Afternoon Session 7</b>		
<b>Session Chair: T. Darland</b>		
12:40 PM	<a href="#">Dailey</a> (G)	NEXT GENERATION CANCER THERAPEUTICS: REVISITING ONCOLYTIC BACTERIA
1:00 PM	<a href="#">Ghosh Dastidar</a> (G)	MECHANISMS OF TRANSCRIPTIONAL REGULATION IN STRESS-INDUCED CANCER CELLS
1:20 PM	<a href="#">Biggane</a> (G)	CENTRAL NORADRENERGIC SYSTEM MANIPULATION ALTERS BRAIN EXCITABILITY IN MODELS OF EPILEPSY
1:40 PM	<i>BREAK</i>	
<b>Afternoon Session 10</b>		
<b>Session Chair: Simsek</b>		
2:00 PM	<a href="#">Mulinti</a> (G)	DEVELOPMENT AND PROCESSING OF SPIDER SILK AS A BIOPOLYMER FOR A HEMOCOMPATIBLE CATHETER COATING
2:20 PM	<a href="#">Hasan</a> (G)	COMBINATION ANTIBIOTIC THERAPY FROM A BONE VOID FILLING PUTTY FOR TREATMENT OF OSTEOMYELITIS
2:40 PM	<a href="#">Rudraraju</a> (G)	A NOVEL ROLE FOR THE TRANSCRIPTION FACTOR SNAIL IN ALTERNATIVE SPLICING

<b>Room 2: Badlands</b>		
<b>Afternoon Session 8</b>		
<b>Session Chair: Rahman</b>		
12:40 PM	<a href="#">Lakey</a> (G)	CATTLE RESPOND TO HIGHER QUALITY FORAGE UNDER PATCH BURNING ON KENTUCKY BLUEGRASS-INVADDED RANGELAND
1:00 PM	<a href="#">Thompson</a> (G)	BORRELIA BURGDORFERI STIMULATES AN INFLAMMATORY RESPONSE IN HUMAN CHOROID PLEXUS EPITHELIAL CELLS
1:20 PM	<a href="#">Smith</a> (G)	DIFFERENTIAL BEHAVIOR RESPONSE IN C57BL/6 AND BALB/C MICE INDUCED BY FOOD ALLERGY
1:40 PM	<i>BREAK</i>	
<b>Afternoon Session 11</b>		
<b>Session Chair: D. Darland</b>		
2:00 PM	<a href="#">Germundson</a> (G)	HLA SPECIFIC CLINICAL AND BEHAVIORAL RESPONSES IN A TRANSGENIC MOUSE MODEL OF COW'S MILK ALLERGY
2:20 PM	<a href="#">Bhattacharya</a> (G)	TRANSCRIPTIONAL MEMORY FOLLOWING AN EMT RESPONSE
2:40 PM	<a href="#">Haring</a> (F)	PROCEED WITH CAUTION! REGULATION OF A COMPONENT CRITICAL FOR THE CELLULAR RESPONSE TO DNA DAMAGE

<b>Room 3: River Valley</b>		
<b>Afternoon Session 9</b>		
<b>Session Chair: Parent</b>		
12:40 PM	<a href="#">Kalbach</a> (G)	AUTOXIDATION OF LINSEED OIL CATALYZED BY COBALT(II): PROBING FUNCTIONAL GROUP CHANGE OVER TIME
1:00 PM	<a href="#">Sun</a> (G)	ONE-POT SYNTHESIS OF RUTHENIUM NANOPARTICLES MODIFIED REDUCED GRAPHENE OXIDE
1:20 PM	<a href="#">Collette</a> (F)	CAN INTERTIDAL GEOMETRY SELECT? STEPS TOWARD UNDERSTANDING A CRYPTIC PULSE OF TERRESTRIALIZATION
1:40 PM	<i>BREAK</i>	



## KEYNOTE SPEAKER

**Dr. Jeffrey Gross** is the E. Ronald Salvitti Chair in Ophthalmology and Developmental Biology at the University of Pittsburgh. He is also the Director of the Louis J. Fox Center for Vision Development, Disease and Regeneration Laboratory Group.

He has a distinguished research history and has worked for 20 years prior to becoming an outstanding mentor, himself. He received his Ph.D. in 1996 from the University of Maryland where he worked on photoreceptor signaling. He was awarded a Ph.D. in 1996 where he conducted his thesis research on early development. He worked with Dr. David McClay. He went on to do his postdoctoral training at the University where he was a critical force behind a mutant target several critical molecular pathways in eye development with dual appointments at the Institute for Cellular and Molecular Biology for Neuroscience at the University of Texas at Austin. He has a reputation on his integrity and his thoughtful approach to development and ocular regeneration. His research, teaching, and mentorship are excellent, and he quickly moved through the academic ranks. He was promoted to Professor in 2015. He has made major contributions to his department and was appointed as the Chair of Graduate Studies Committee for the Cell and Molecular Biology. He was appointed as the Associate Director for the Institute for Cellular and Molecular Biology. Over the years, he has been very active in professional service where his leadership skills and ability to work effectively with others have been much appreciated.



He moved to his current position at the University of Pittsburgh School of Medicine in 2015 where his research focuses on ocular development, disease and regeneration largely using zebrafish as a model system. The overall goal of his lab team is to progress towards understanding the epigenetic regulation of retinal development from progenitor cell to differentiated neuron, and how these processes could operate during regeneration. His current research emphasis is founded on the premise that characterization of the molecular mechanisms of eye development in zebrafish promises to facilitate a better understanding of human pathologies. Since the zebrafish regenerates its retina after injury, this is an ideal system through which the molecular underpinnings of the regenerative process can be elucidated, and potential therapies developed and/or tested.

## **BARBARA ANN EARWICKER AWARD**

### **FOR EXCELLENCE IN RESEARCH AND SCIENTIFIC COMMUNICATION**



This award is conferred to an individual who has demonstrated excellence in the quality of their research as well as their ability to communicate clearly and effectively to a broad audience. This award is given in memory of Barbara Ann Earwicker, who was a passionate advocate for education and a lifelong learner. Barbara was born in Brooklyn, New York on July 21, 1938 and lived her life with energy, tenacity, and integrity.

She was an excellent communicator, read widely, and had a broad range of interests, never hesitating to tackle a new topic area or acquire a new skill. She was a creative and thoughtful individual, devoted to family and friends, and she gave much of herself in service to others. She passed away on June 22, 2011 after having lived every moment of her life to its fullest.

This award is a celebration of her commitment to education, to learning, and to family.

**UNDERGRADUATE COMMUNICATIONS**

IN THE

A. RODGER DENISON COMPETITION

(Communications are listed alphabetically by the last name of the presenting author)

**DELETION OF AUXIN BINDING PROTEIN-1 INCREASES STRATIFICATION AND DECREASES LATERAL ROOT INITIATION**

Brody J. Burnett and Christopher P. Keller

*Biology, Minot State University, Minot, ND*

Auxin (indole-3-acetic acid) controls aspects of development in plants. Binding of auxin to the TIR1 family of nuclear receptors alters gene expression while rapid non-genomic auxin effects may be mediated through Auxin Binding Protein-1 (ABP-1). Arabidopsis plants homozygous for an *abp1* null allele, however, reportedly develop nearly normally in the light. Because, hypocotyl growth in the dark rapidly responds to auxin, here we ask if ABP-1 plays a role in dark development. We compared time to germination, hypocotyl and primary root growth, and lateral root initiation in wild type (Col-0) Arabidopsis with that of the *abp1-c1* null mutant. Wild type and *abp1-c1* seeds were planted on agar with both seed types planted in each petri dish for identical growth conditions. *Abp1-c1* null mutants displayed an increased stratification (cold pre-treatment) requirement. For example, after 48 hours, germination was 88.4% +/- 5.4 for wild versus 8.3% +/- 2.2 for *abp1-c1* with zero stratification, 81.4% +/- 0.87 for wild type versus 39.3% +/- 1.7 for *abp1-c1* with four days stratification, and 95.9% +/- 0.87 for wild type versus 98.4% +/- 3.0 for *abp1-c1* with eight days stratification. Wild type hypocotyl length and primary root length were similar but wild type plants initiated more lateral roots sooner. These results show a role for *abp1-c1* plays a previously unrecognized role in mediating stratification as well as lateral root initiation.

Support: Research reported in this publication was supported by an Institutional Development Award (IDeA) from the National Institute of General Medical Sciences of the National Institutes of Health under grant number P20GM103442.

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## **SENSITIZING AML CELLS TO DIFFERENTIATE WITH ATRA**

Bikalpa Ghimire\*, Kalsi Heimdal, Heidi Super

*Department of Biology, Minot State University, Minot, ND*

Human acute myeloid leukemia (AML) is associated with recurrent chromosome translocations, which create oncoproteins that block differentiation and promote proliferation of myeloid cells. The Myeloid Lymphoid Leukemia gene (MLL) is frequently involved in these translocations and is considered a driver of AML. Differentiation promoting drugs, such as all-trans-retinoic acid (ATRA), are an attractive alternative to cytotoxic chemotherapy, but few types of AML respond to ATRA. We hypothesize that specific genes must be activated or inhibited in AML for ATRA to induce differentiation. Our initial studies focused on two AML cell lines, MV4;11 and THP-1, with alterations in the MLL gene, and one non-MLL related AML cell line, U937. The cells were treated with epigenetic modifiers, including tranylcypromine (TCP), N-acetyl-dinaline (CI-994), and 3-deazaneplanocin A (DZNep) to alter global gene expression. Multiple parameters were examined to monitor myeloid differentiation. By all measures, all three drugs seemed to sensitize U937 and THP-1 cells to differentiate when treated with ATRA. MV4;11 cells showed partial differentiation with ATRA when treated with CI-994 or DZNep. These experiments suggest epigenetic inhibitors may alter gene expression to increase sensitivity to ATRA differentiation therapy, but the response may still be dependent on the specific gene alteration driving the AML.

Support: Research supported by an Institutional Development Award (IDeA) from the National Institute of General Medical Sciences of National Institute of Health under grant number P20GM103442

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## NOVEL METHOD FOR THE SYNTHESIS OF DIBENZYL METHYLAMINES VIA THE LEUCKART REACTION

Tess A. Skinner\*, Lioudmila I. Bobyleva, and Mikhail M. Bobylev

*Chemistry, Minot State University, Minot, ND*

Recently, we developed a rapid procedure for the synthesis of substituted N-benzyl-N-methylformamides. Interestingly, in the reaction conducted on 4-chlorobenzaldehyde, a large amount of a by-product, N,N-di-(4-chlorobenzyl)-N-methylamine was produced with an isolated yield of 31.3%. N-(4-chlorobenzyl)-N-methylformamide was produced with an isolated yield of 52.0%.

We hypothesized that increasing the molar ratio of 4-chlorobenzaldehyde to N-methylformamide (from 1:25 to 1:5) should produce a higher yield of the respective dibenzyl product and thus turn it into the main product of the reaction.

The reaction was conducted on a 10 mmol scale at 188 degrees Celsius. Column chromatography was used for the isolation of the products. NMR-spectroscopy and elemental analysis were used to determine the structures of the products.

The reaction was completed in 10 minutes. The isolated yields of N,N-di-(4-chlorobenzyl)-N-methylamine and N-(4-chlorobenzyl)-N-methylformamide were 65.0% and 23.3%, respectively. The ratio of the yield of the dibenzyl product to the yield of the monobenzyl product shifted from 1:1.66 in the previous reaction to 2.79:1 in this reaction. N,N-di-(4-chlorobenzyl)-N-methylamine thus became the main product of the reaction. The results of the reaction support the initial hypothesis. The reaction provides a new method for the synthesis of N,N-di-(4-chlorobenzyl)-N-methylamine.

Support: The project was supported by NIH grant 8 P20 GM103442-12 from the National Institute of General Medical Sciences and by NSF RII Track-1 Award #1355466.

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**GRADUATE COMMUNICATIONS**

**IN THE**

**A. RODGER DENISON COMPETITION**

(Communications are listed alphabetically by the last name of the presenting author)

**SCALABLE PREPARATION A CIS-CYCLOBUTANE-1,2-DICARBOXYLIC ACID FROM  $\beta$ -TRANS-CINNAMIC ACID.**

Houssein S. Amjaour, Zhihan Wang, Micah Mabin, and Qianli R. Chu

*Houssein S. Amjaour, Zhihan Wang, Micah Mabin, and Qianli R. Chu*

Dicarboxylic acids are currently used in a wide range of applications, from polymers to metal-organic materials (MOMs) to medicines. Phthalic acid, succinic acid, and adipic acid in particular are widely used in plastics. The downside to these types of dicarboxylic acids is that they are all derived from petroleum, a nonrenewable resource. Recently, cyclobutane-containing diacids (CBDAs) have shown promise as biomass-derived alternatives to these chemicals. They can be readily prepared from a number of commercially-available bio-based starting materials using clean, efficient [2+2] photocycloaddition. This process dimerizes suitable molecules to form a cyclobutane ring between them. For example, CBDA-1 ( $\alpha$ -truxillic acid) and CBDA-4 ( $\beta$ -truxinic acid) can be synthesized from different polymorphs of the bio-renewable molecule cinnamic acid. Recently, our group has reported that this process can be thermally reversed for CBDA-4, making this diacid building block readily recyclable.

Support: Support: National Science Foundation Grant (NSF EPSCoR Award IIA-1355466).

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**GRAVIN/AKAP12 PLAYS A ROLE IN ENDOTHELIAL CELL MIGRATION AND ANGIOGENIC SPROUTING**

Ashrifa Ali\*, Alessandra Spagnolia (1), Marcus Geffre (1) &amp; Bryon D. Grove (1)

*(1) Biomedical Sciences, University of North Dakota School of Medicine and Health Sciences, Grand Forks, ND*

Angiogenesis and vascular integrity are regulated by many angiogenic factors through a network of pathways that include Src and PKA dependent signaling. How this network of signaling pathways is integrated is poorly understood, but scaffolding proteins may play a role by serving as a platform to target multiple signaling proteins to specific compartments. We postulate that Gravin/ AKAP12 serves such a role. Gravin, a scaffolding protein that is expressed as two variants in endothelial cells (EC), binds several signaling proteins, including PKA and Src, which are known to regulate EC migration and angiogenesis. To investigate a role for gravin in angiogenesis, we conducted knockdown and knockout experiments using a 3D collagen model of angiogenic sprouting. Knockdown of both gravin variants decreased the density of angiogenic sprouts. Using CRISPR Cas9, we created a knockout cell line expressing only variant 2 of AKAP12 (gravin V.2). These cells had a slower growth curve in culture than WT cells and, when cultured on collagen gels, showed significantly fewer sprouts than WT cultures. Confocal microscopy revealed that fewer gravin V.2 cells migrated into collagen gels, resulting in shorter sprouts with fewer branches than WT cells. Interestingly, gravin V.2 cells migrated faster on 2D surfaces and through Transwell membranes than WT cells. These findings are consistent with the hypothesis that gravin variants play a role in regulating EC migration and angiogenic sprouting.

Support: Supported by NIH grants P30GM103329, P20GM103442 and P20GM113123

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**TRANSCRIPTIONAL MEMORY FOLLOWING AN EMT RESPONSE**

Atrayee Bhattacharya\*, Danielle Perley, Adam Schiedegger and Archana Dhasarathy

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Transcriptional memory involves a rapid or robust transcriptional response to a previously encountered stimulus, and is modulated by epigenetic mechanisms. Transcriptional memory is propagated across several generations, enabling cells to remember & maintain their lineage. The Epithelial to Mesenchymal Transition (EMT) is a reversible transcriptional response that converts epithelial to mesenchymal cells, and is integral to development and metastasis. It is unclear whether an EMT stimulus can be remembered in successive generations, even with removal of the original stimulus. To study this, we established a model for transcriptional memory using mouse NMuMG cells treated with TGF- $\beta$  to induce EMT. One set of cells was vehicle-treated (VT) for 10 passages, and the second treated with TGF- $\beta$  for one passage (1X) and untreated for 9 passages. The phenotype and transcriptional profiling of the 1X cells resemble the VT cells, however when re-exposed to TGF- $\beta$ , the 1X cells mounted a more robust transcriptional response of a group of genes, indicating that they were potentially “memorized”. We looked for epigenetic marks that contribute to cellular memory and found that both H3K4me1 and H3K27Ac are present at high levels at SNAIL promoter in the 1X relative to VT cells. We are further investigating chromatin structure changes that contribute to establishment of transcriptional memory.

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## **CENTRAL NORADRENERGIC SYSTEM MANIPULATION ALTERS BRAIN EXCITABILITY IN MODELS OF EPILEPSY**

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This study aimed to elucidate the antiepileptic effects of norepinephrine. Our experiments utilized pharmacological manipulation and genetically modified mice to investigate subtype-specific effects of the adrenergic receptors, which facilitate norepinephrine action. This study focuses on the alpha1-Adrenergic Receptor (alpha1-AR) class. Broadly stated, our hypothesis is that alpha1A-AR subtype activation is responsible for the antiepileptic effects mediated by the alpha1-AR class.

We tested this hypothesis using behavioral observation and electrophysiological recordings. Wild-type control (WT) or knockout (KO) mice lacking alpha1A-ARs or alpha1B-ARs were used in this study. Experiments included observation of spontaneous or induced seizure activity and electrophysiological recordings of epileptiform events in hippocampal slices.

Experimental results showed that alpha1A-AR KO mice were vulnerable to spontaneous seizures and intensified epileptiform activity and that alpha1A-AR activation attenuates epileptiform activity in normal mice. Results from alpha1B-AR KO experiments revealed little to no participation from this receptor subtype. From our results, we can conclude that the alpha1A-AR is important for maintaining seizure threshold and is important for AR mediated antiepileptic effects. These results may suggest a novel therapeutic target for epilepsy and may suggest a potential importance of alpha1A-AR expression for maintaining normal brain excitability.

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**NEXT GENERATION CANCER THERAPEUTICS: REVISITING ONCOLYTIC BACTERIA**

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Despite the growing range of available therapeutics, less than fifty percent of pancreatic cancer cases end with the complete eradication of diseased cells. These statistics demand a paradigm shift for the next generation of cancer treatments. In part, current therapeutics are limited by the inability to deliver drugs into avascular areas. However, the use of *Clostridium novyi* has overcome this challenge with its ultrasensitive, innate affinity for hypoxic and necrotic areas, such as those found at the center of solid tumors and their metastases. While clinical and preclinical data from intratumoral injections of *C. novyi* offers a promising new therapy, not all tumors are accessible to such injections. Unfortunately, in preclinical trials analogous IV injections have uncovered other obstacles such as rapid clearance of *C. novyi* by the immune system and off-target sepsis. The current research hypothesizes that by using a custom designed CRISPR system, genetic modifications to a non-toxic form of *C. novyi* will allow for the expression of both the tumor targeting RGD peptide as well as non-immunogenic spider silk protein on the surface of the sporulated bacteria. While RGD will act as a potent targeting system, spider silk will act like a “cloaking device”, allowing the bacteria to remain in the blood stream longer in order to locate and destroy the tumor(s).

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## **HLA SPECIFIC CLINICAL AND BEHAVIORAL RESPONSES IN A TRANSGENIC MOUSE MODEL OF COW'S MILK ALLERGY**

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Cow's milk has been observed to trigger behavioral abnormality in certain sensitive individuals. We previously demonstrated that altered behavior and gut and brain pathology are observed in a mouse model of cow's milk allergy. To more closely model human conditions, we utilized transgenic mouse strains that express allelic variants of class II human leukocyte antigen (HLA-II), which is important in human allergy development and immune responses, instead of mouse major histocompatibility complex. We hypothesized that HLA-II variance may render individuals susceptible to allergy-triggered neuropsychiatric conditions. To test this hypothesis, we sensitized male and female HLA-DR3, -DR15, and -DQ8 transgenic mice to a cow's milk protein, beta-lactoglobulin (BLG), for 5 weeks followed by BLG challenge in week 6. BLG-sensitized DR3 mice showed the greatest clinical responses among the 3 strains at 30 min post-challenge. When behavior tests were performed the next day, BLG-sensitized DR15 mice demonstrated sex-dependent abnormality, with males showing decreased mobility in the open field test and females displaying impaired spatial memory in a cross maze. Behavior of DR3 and DQ8 mice was unchanged by BLG sensitization, demonstrating that variance in HLA-II resulted in distinct clinical and behavioral responses. While the mechanism and pathophysiology need to be elucidated, HLA-II variance may play a role in the manifestation of food allergy-mediated behavioral disorders.

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Ghosh Dastidar  
Graduate  
Talk

## **MECHANISMS OF TRANSCRIPTIONAL REGULATION IN STRESS-INDUCED CANCER CELLS**

Sayantani Ghosh Dastidar, Bony De Kumar, Nii-Koney Kwaku Koney, Mariia Vlasenok, Sergei Nechaev

*University of North Dakota*

My work investigates transcriptional responses of cancer cells in response to different stresses such as heat-shock and arsenic. The goal of my project is to determine if response to stimuli a predisposition of cells that is established in their ground state. I used breast cancer cells and exposed them to different stresses such as heat shock and arsenic – both of which activates heat-shock response (HSR) pathway. We then measured functional output in terms of transcription factor binding and nascent RNA transcription using high-throughput techniques such as ChIP-seq and PRO-seq. We found high levels of HSF-1 activation in both the stimulus and categorized their distribution. We also compared transcriptional response between different cell lines and found stark difference in mechanisms controlling gene activation and repression. Further work will elucidate what other factors are involved in stress-response of cells.

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**COMBINATION ANTIBIOTIC THERAPY FROM A BONE VOID FILLING PUTTY FOR TREATMENT OF OSTEOMYELITIS**

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Total Joint Replacement (TJR) is projected to be the number one elective surgery in USA with 5 million surgeries/year by 2030. Infection remains the major cause for revision TJR surgery, accounting for ~25% of the revision. The infection rate can be as high as 20-30% after revision surgery. Current treatment with non-biodegradable bone cement followed by debridement does not provide adequate local antibiotic concentration and play a role in the emergence of threatening level of antibiotic resistance due to persistent bacterial presence at surgical site and does not provide osseointegration while needing an additional surgery to be removed. Moreover, single drug therapy often fails to eradicate bacterial biofilm infection. We developed combination Antibiotic-Releasing Bone Void Filler (ABVF) putty implant which contains osseointegrating PROOSTEON embedded in a polymer matrix that provides sustained drug release. ABVF provided sustained delivery of antibiotics for up to six weeks in-vitro with efficient antibacterial and antibiofilm activity. In in-vivo rat infection model the easily press-fitting ABVF was implanted in a critical sized defect in tibia infected with  $10^8$  CFU of *Staphylococcus aureus*. ABVF cured the infection and supported osseointegration and bone growth while degrading in treatment rats. Control rats sustained severe osteomyelitis and had unhealed bone defect. The ABVF combination antibiotic therapy can be a promising option to treat the infections after TJR.

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**DESIGNING RU CATALYSTS FOR SELECTIVE C-H BOND OXIDATION REACTIONS**

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Selective C-H bond oxidation under mild conditions is a large challenge due to the relative ease of overoxidation. Various transition metal catalysts have been employed in these kind of oxidation reactions in an attempt to improve their selectivity. One of the important area of C-H bond activation is the C-H bond hydroxylation. Typically, high-valent metal-oxo species are the key intermediate in C-H bond activation reactions. Our group is focusing on developing Ru catalysts for the selective oxidation of unactivated C-H bonds by introducing phosphate anionic ligands to the complex thereby lowering the reduction potential in the complex via proton-coupled electron transfer (PCET). By lowering the reduction potential of Ru complexes, we expect to reduce the potential for overoxidation and enable the use of benign oxidizing agents. This presentation will highlight our initial attempts to develop these ruthenium catalysts and an analysis of their electrochemical and catalytic behavior.

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**AUTOXIDATION OF LINSEED OIL CATALYZED BY COBALT(II): PROBING FUNCTIONAL GROUP CHANGE OVER TIME**

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Autoxidation of drying oils has been extensively studied, however the mechanism of catalysis by transition metal-based catalysts remains poorly understood. Out of the transition metal series, cobalt(II) salts have been used for decades, however these compounds have been recently categorized as class 1B carcinogens according to the International Agency for Research on Cancer (IARC). In order to avoid this health hazard, it would be preferable to use driers based on iron, but iron catalysts typically have poor drying performance and cause discoloration. In order to enable the rational development of improved Fe driers, we are developing a structure-function relationship for Co driers by measuring the rates of linseed oil drying with various Co complexes via IR spectroscopy, and using this relationship to improve our understanding of the mechanism of drying by these complexes. In this presentation, we will discuss our current progress toward characterizing the mechanism of linseed oil drying with Co.

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## **CATTLE RESPOND TO HIGHER QUALITY FORAGE UNDER PATCH BURNING ON KENTUCKY BLUEGRASS-INVADDED RANGELAND**

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Heterogeneity is essential to maintain rangelands that evolved with fire and grazing, and important in maintaining forage diversity. By combining season-long grazing with a yearly rotation of dormant- or growing-season fires, patch burn-grazing (PBG) creates contrasting patches of forage quality and quantity in a pasture. This heterogeneity optimizes rangeland value for livestock and wildlife. High forage quality in burned patches should attract livestock; this attraction should maintain forage quantity contrast over the season. We sought to increase forage heterogeneity by applying a rotational PBG treatment to pastures with season-long grazing. We monitored forage quality, biomass, and grazer occupancy for 2 years of a 4 year PBG rotation. We determined forage biomass by clipping 25 cm<sup>2</sup> quadrats in burned and unburned patches once per month over the growing season. At each point, we counted fecal pats within 5 m of the point to determine grazer usage of each patch. All clippings were run through near infrared spectroscopy (NIR) to quantify forage quality. Quality was higher in recently-burned patches where biomass was lowest. Biomass in burned patches increased over the growing season; unburned patches were stable. Grazer occupancy was highest in burned patches. This attraction increased over the growing season. We expect continued grazer attraction to the most recently-burned patches, and a gradient of forage quality and quantity as the burn patches shift.

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Liu  
Graduate  
Talk

## GRAPHENE OXIDE-BASED ASSAY FOR SENSITIVE FLUORESCENCE DETECTION OF DNA EXONUCLEASE ACTIVITY

Xiao Liu, Yingfen Wu, Xu Wu, Julia xiaojun Zhao

*University of North Dakota*

3'-5' exonuclease enzymatic activity makes important contributions to multiple physiological processes, such as accurate DNA replication and DNA repairing. In this article, we have designed a sensitive graphene oxide (GO)-based sensor for the detection of exonuclease enzymatic activity. A fluorophore tagged hair-pin structured DNA strand is firstly adsorbed on the surface of GO due to the  $\pi$ - $\pi$  interaction between the long loop DNA sequence and GO, causing the fluorescence quenching via fluorescence resonance energy transfer (FRET). However, in the presence of exonuclease III (Exo III), the fluorescence recovers because of the digestion of the fluorophore tagged 3'-hydroxyl termini of the stem portion, releasing the fluorophores from the GO surface. This simple graphene oxide-based sensor shows high sensitivity and selectivity towards Exo III, with the linear range of 0.01U/mL to 0.5 U/mL and a limit of detection (LOD) of 0.001U/mL. Comparing with other fluorescent sensors, this design is not only simple and low-cost but also exhibits superior sensitivity and selectivity in both buffer and fetal bovine serum.

Support: NSF grant CHE 0947043

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## **EFFECTS OF NON-CONVENTIONAL GAS AND OIL PRODUCTION ACTIVITIES ON FINE PARTICLES & GROUND LEVEL OZONE**

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Non-conventional oil and gas production in North Dakota and Texas has been rising significantly since 2007 with the advances in hydraulic fracturing technology. The goal of this study was to investigate the effects of unconventional energy production on two types of air pollutants (fine particles and ground-level ozone). By analyzing the air quality data from publicly accessible sources, focusing on two major oil producing states (North Dakota, Texas) and two control states (Minnesota and Connecticut). The specific objectives of this study were to understand 1) the effects of unconventional oil/gas production on the regional air quality; 2) the annual and seasonal variations of criteria air pollutants in these states. This study focuses on two selected criteria air pollutants particulate matter (PM<sub>2.5</sub> and ground-level ozone). From the data analysis, we observe PM<sub>2.5</sub> level and ground-level ozone and seasonal trend and the annual average of PM<sub>2.5</sub> and ozone in oil producing and non-producing states from the year 1999 to 2015.

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Mohammad  
Graduate  
Talk

## **GENOME-SCALE CRISPR-CAS9 SCREENING TO IDENTIFY CYTOTOXIC MECHANISMS OF PIPERLONGUMINE IN PDAC CELL**

Jiyan Mohammad and Katie Reindl

*North Dakota State University*

Pancreatic ductal adenocarcinoma (PDAC) is an aggressive malignancy that lacks early detection and diagnosis. Despite recent advances in the field of oncology, less than 9% of PDAC patients survive for five years or more after diagnosis. Conventional treatment approaches such as chemotherapy, radiation therapy, and resection surgeries have been largely ineffective for PDAC. Novel treatment strategies, based on the unique molecular biology and physiology of pancreatic cancer, are now being investigated for their potential use in clinics. We have reported piperlongumine (PL), a novel cancer cell-specific cytotoxic agent, causes cell death in PDAC cells in vitro and in vivo. PL is a bioactive compound obtained from Piper longum plant. Its primary protein target is glutathione S-transferase Pi, and the proposed mechanism of action by which PL causes cell death is by disrupting the redox homeostasis. To investigate additional molecular mechanisms by which PL kills PDAC cells, we used a CRISPR-Cas9 system to individually knockout expression of 2,500 cancer-associated genes in PDAC cells treated w/ or w/out PL. We identified potential sensitizers, which are proteins whose loss enhanced PL-induced cell death. Further, we identified potential antagonizers, which are proteins whose loss prevented PL-induced cell death. Altogether, our screening data confirmed our previous results indicating PL is involved in cell cycle regulation, the TP53 pathway, and the MAPK signaling pathway

Support: United States

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## **DEVELOPMENT AND PROCESSING OF SPIDER SILK AS A BIOPOLYMER FOR A HEMOCOMPATIBLE CATHETER COATING**

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Tailored surface coatings have been used for decades to improve materials performance in blood. Among different approaches, heparin based biomedical coatings have found great success in the commercial catheter market. However, they have their own limitations. Coating of a vascular device with a heparin binding peptide (HBP), which can sequester the endogenous circulating heparin, presents numerous advantages over both systemic heparin therapy and direct heparin bound surfaces. Embedding HBP in a silk biopolymer provides the mechanical integrity necessary under dynamic flow conditions for both proper placement of the catheter and to maintain proper blood flow. This fusion protein (S4H4) was cloned and expressed in bacteria and analyzed for its heparin binding activity using ELISA and anticoagulant activity which showed successful adherence of heparin to it and anticoagulant property. It was then assessed as a surface coating polymer. Protein was coated on a catheter surface by dip coating and the coating was evaluated via SEM imaging, XPS which showed successful deposition of coating. It was also evaluated for antimicrobial property on the coated tubes. This study proves the successful production of a silk-based biopolymer that can be embedded with a heparin-binding functionality to create a device coating. This unique approach may prove effective to address and resolve many of the issues like infection, and thrombosis surrounding the use of blood-contacting medical devices.

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Nayakasinghe  
Graduate  
Talk

## **POLARITY ENHANCEMENT OF SILICATENE STRUCTURES BY DOPING WITH ALUMINUM: A 2D ANALOG FOR ZEOLITES**

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Catalyst particle agglomeration is a common problem encountered in heterogeneous catalysis. It can be avoided by promoting strong catalyst-support interactions. Silica is a potential industrial catalytic support, which is inert in nature. In this study, the chemical reactivity of thin (two dimensional) crystalline silica films (silicatene, 2D SiO<sub>2</sub>) were enhanced by doping with Al, which can be considered as a potential catalytic support with reduced sintering effects.

Silicatene films were epitaxially grown on Mo(112) and characterized by Auger electron spectroscopy (AES), low energy electron diffraction (LEED), and thermal desorption spectroscopy (TDS) at ultra-high vacuum (UHV). Al-doped silicatene (2D-zeolites) were prepared by controlled vapor deposition of metallic Al on silicatene, followed by post-annealing at UHV, and extensively characterized by AES.

According to water-adsorption kinetics measurements, Al-doped silica exhibits hydrophilic characteristics compared to hydrophobic silicatene, which reflects the enhanced chemical reactivity due to the induced polarity.

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**ASSOCIATION MAPPING FOR SCLEROTINIA STEM ROT RESISTANCE IN A WORLD  
COLLECTION OF BRASSICA NAPUS L.**

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of Plant Pathology, North Dakota State University, Fargo, ND*

Sclerotinia stem rot (SSR) caused by *Sclerotinia sclerotiorum* (Lib.) de Bary is one of the most destructive fungal diseases of *Brassica napus* (L.). It reduces the seed yield, oil content, and quality. In North Dakota, the average yield losses is estimated at 13-50%, and economic losses is estimated up to 20.8 million dollars. Since there is no completely resistant cultivars available, identification of resistant genotypes and genes in diverged germplasm accessions is one of the best options to develop durable disease resistant cultivar for the growers. In this study, a panel of 218 germplasm accessions were evaluated in a controlled environment using RCBD with three replicates, to identify potential resistant germplasm. The germplasm were evaluated using single isolate by mycelial stem inoculation at flowering stage. For each accession, lesion length, percentage of the main stem girdled by the lesion, and mortality (%) were recorded on 3, 5, 7, 9, 11, 13 and 15 days after inoculation. Seven promising lines have been identified as tolerant based on lower stem lesion length, the percentage of stem girdling, and mortality. The germplasm accessions have been genotyped using Illumina genotyping-by-sequencing (GBS) platform at the Institute for Genomic Diversity at Cornell University, and 42,575 single nucleotide polymorphisms have been identified. Finally, genome-wide association study will be conducted to identify the genomic region containing SSR resistant genes in *B. napus*.

Support: The study was supported by the National Sclerotinia Initiative.

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## **A NOVEL ROLE FOR THE TRANSCRIPTION FACTOR SNAIL IN ALTERNATIVE SPLICING**

Smruthi Rudraraju, Dr. Atrayee Ray, Dr. Janani Kumar, Shawn Krueger, Dr. Humaira Qureshi, Adam Scheiddeger, Dr. Archana Dhasarathy

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The transcription factor SNAIL is one of the key regulators of the first step of cancer metastasis, Epithelial to Mesenchymal Transition. This process is characterized by a cell-state shift from the highly differentiated epithelial phenotype to the less differentiated migratory mesenchymal phenotype. SNAIL binds to E-box motifs in promoter regions and recruits chromatin remodelers to repress or activate gene expression.

Mass spectrometry, immunofluorescence, and co-immunoprecipitation data from our lab indicate that SNAIL associates with splicing protein SRSF1. Co-immunoprecipitation performed after RNase treatment suggests SNAIL-SRSF1 association is RNA-dependent. RNA Immunoprecipitation followed by PCR, as well as rEMSA data, suggest that SNAIL binds to RNA, specifically to the IIIc exon of FGFR1, a protein known to be alternatively spliced. Because SRSF1 is a well-established regulator of alternative splicing, we hypothesize that SNAIL regulates alternative splicing by binding to RNA and recruiting SRSF1. We further predict that because transcription and splicing are closely coupled, transcription factor regulation of splicing through RNA binding is utilized by other biological systems to alter phenotype in response to external stimuli. We are currently investigating genome-wide changes in alternative splicing regulated by SNAIL, and the associated mechanism by which SNAIL interaction with the spliceosome leads to alternative splicing.

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## **GSTP1 REGULATES PANCREATIC CANCER GROWTH THROUGH ITS INVOLVEMENT IN OXIDATIVE STRESS PATHWAYS**

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GSTP1 is a cytosolic enzyme that metabolizes xenobiotic compounds and byproducts of cellular metabolism. GSTP1 is overexpressed in ovarian, colon, breast, and pancreatic cancer and is also abundant in drug-resistant cancer cells. The reasons for higher expression ratios compared to normal tissues or wild-type cell lines are not well understood. We investigated the role of GSTP1 in the pathogenicity of pancreatic ductal adenocarcinoma (PDAC). We generated GSTP1 knockdown PDAC cell lines. GSTP1 knockdown impaired the in vitro growth and proliferation of PDAC cells. Orthotopic implantation of GSTP1 knockdown cells in the pancreata of the athymic nude mice resulted in reduced tumor weight and volume compared to control tumors. Tumor growth was monitored and tumor volume was calculated every ten days using a Vevo3100 ultrasound imaging system. Histological analysis of the tumors generated from GSTP1 knockdown PDAC cells revealed reduced expression of Ki67 while elevated levels of cleaved caspase3 were found. GSTP1 knockdown cells exhibit a significant change in the expression of p53-responsive genes and oxidative stress-responsive genes involved in cell death and DNA repair pathways. Transcriptome analysis of GSTP1 knockdown cells provide evidence that GSTP1 is involved in the chemoresistant behavior of PDAC cells. Collectively, our data suggest that GSTP1 plays a salient role in the growth and proliferation of PDAC cells and is a novel therapeutic target for PDAC.

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**DIFFERENTIAL BEHAVIOR RESPONSE IN C57BL/6 AND BALB/C MICE INDUCED BY  
FOOD ALLERGY**

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Allergic hypersensitivity is often found comorbid with neuropsychiatric disorders, including attention deficit hyperactivity, autism spectrum, and anxiety disorder. Though classic allergic symptoms are well defined, it is evident that subclinical allergic hypersensitivity exist and remain undiagnosed. A central factor in the establishment, provocation, and peripheral to central signaling of allergic symptoms are helper T-cells and their cytokines. To understand how differing T-cell immune bias can alter clinical presentation of allergy we sensitized helper T-cell type 1 biased C57BL/6 and helper T-cell type 2 biased BALB/c mice to the milk protein  $\beta$ -Lactoglobulin (BLG). Starting at 4 weeks of age, the mice were sensitized via weekly oral gavage of BLG in the presence of cholera toxin as an adjuvant. Utilizing behavioral tests, clinical anaphylaxis scoring, and serum BLG-specific IgE ELISA we profiled the lasting effects in sensitized mice post-allergen exposure. BLG-sensitized C57BL/6 mice present no anaphylactic symptoms, but increased serum BLG-specific IgE. Additionally, C57BL/6 mice display subtle anxiety-like behavior when tested with an elevated-zero maze. In contrast, BALB/c mice exhibit anaphylactic symptoms and anxiety-like behavior orders of magnitude great than matched C57BL/6 mice in both elevated zero maze and open field tests. From these results, we see that mice with differing immune predisposition have differing responses to allergic challenge.

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## ONE-POT SYNTHESIS OF RUTHENIUM NANOPARTICLES MODIFIED REDUCED GRAPHENE OXIDE

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Here, we report a one-pot preparation method of reduced graphene oxide/ruthenium (oxide) composites (RGO/Ru (oxide)). The RGO has better electrical and thermal conductivity than graphene oxide (GO), and the function groups of carboxyl, epoxy, carbonyl, and hydroxyl provide active sites for further chemical modifications. When RGO modified with inorganic nanomaterials (e.g., Au, Ru, TiO<sub>2</sub>, SiO<sub>2</sub>, quantum dots, etc.), the composites have found applications in fields of supercapacitor, lithium battery fabrication, biosensors, and drug delivery. Ruthenium-based nanoparticle (Ru-NPs) such as metallic Ru and RuO<sub>2</sub> have shown much higher activity at lower temperatures and pressures in ammonia synthesis than the conventional iron catalyst. The RGO/Ru (oxide) composites combined the electrical conductivity properties of RGO and the redox properties of Ru-NPs, which would benefit to the ammonia synthesis.

In this work, the synthesis is based on a single step for the reduction of RuCl<sub>3</sub> into Ru-NPs and GO into RGO with the using of glucose as the reducing agent and the stabilizer. The developed hybrid material was characterized by using TEM, SEM, EDS, UV-Vis absorption spectroscopy, XRD, and DLS. This developed hybrid material will be finally applied as an electrode catalyst on the cathode side to stimulate the solid-state electrochemical synthesis of ammonia.

Support: DOE

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## **A NEW MACRO-SCALE HYDROLOGIC MODEL FOR DEPRESSION-DOMINATED COLD CLIMATE REGIONS**

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Macro-scale hydrologic models provide spatiotemporal simulations of hydrologic processes. The objectives of this study are to develop a Macro-scale Hydrologic Processes Simulator (Macro-HyProS) for cold climate regions with depression-dominated terrains and to evaluate the impacts of micro-topography and spatiotemporal scales on the macro-scale modeling. Macro-HyProS is a grid-based hydrologic model of a unique structure to deal with hydrologic complexities. The model incorporates a LEGO-fashion horizontal layout to account for sub-grid land use heterogeneity. On the vertical layout, each grid consists of different bands, in which hydrologic processes are simulated. To improve macro-scale simulations, a joint modeling framework was developed to take advantage of a cross-calibration scheme between Macro-HyProS and the Soil and Water Assessment Tool. Moreover, an improved snow model was developed to account for the effects of sub-daily temperature fluctuations on snowmelt simulations. The modeling results highlighted the feasibility of the joint modeling framework in analyzing the spatiotemporal trends of hydrologic variables. Also, Macro-HyProS improved the physically-based representation of the snowmelt process. Macro-HyProS provides large-scale simulations of various hydrologic variables and can be linked to other models to address long-term regional water resources issues.

Support: This material is based upon work supported by the National Science Foundation under Grant No. EAR-0907588 and NSF EPSCoR Award IIA-1355466. The North Dakota Water Resources Research Institute also provided partial financial support in the form of a graduate fellowship for the first author.

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## **BORRELIA BURGdorFERI STIMULATES AN INFLAMMATORY RESPONSE IN HUMAN CHOROID PLEXUS EPITHELIAL CELLS**

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The main functions of the choroid plexus are the production of cerebral spinal fluid (CSF) and the formation of the blood-CSF barrier. This barrier allows for the exchange of specific nutrients, waste, and peripheral immune cells between the blood stream and CSF, while inhibiting the entrance of other solutes. *Borrelia burgdorferi* (Bb), the causative bacteria of Lyme disease, is associated with neurological complications including meningitis – indeed, Bb has been isolated from the CSF of patients. While it is accepted that Bb can enter the central nervous system (CNS) of patients, how and where the bacteria enters the CNS is unknown. We hypothesize that Bb will induce an inflammatory response and alter the tight junctions between choroid plexus cells. Primary human choroid plexus cell cultures were infected with Bb for 48 hours. RNA sequencing was used to determine changes in gene expression and was followed by protein analysis. Our study shows that Bb elicits a specific chemokine and cytokine inflammatory response as well as an interferon response (Type I, II). Additionally, genes related to adherens and tight junctions were shown to be down regulated. These results highlight the impact of Lyme disease and its possible role in altering the integrity of the blood-CSF barrier at the choroid plexus.

Support: Global Lyme Alliance, NIH

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## **EFFECT OF SIMULATED HAIL DAMAGE ON YIELD LOSSES OF CANOLA**

Jonathan Vollmer\*, and Mukhlesur Rahman

*North Dakota State University*

Hail damage in canola has been characterized with a variety of symptoms such as randomly broken stems and loss of plants per unit of area. The effect on non-uniform stand reduction and stem cut-off on seed yield reduction has yet to be addressed. Two separate experiments, stand reduction and stem cut-off, were conducted at three locations using RCBD with factorial arrangement, with four growth stages (rosette, bolting, 50% flowering, 90% flowering) and five levels of stem cut-off /stand reduction (0%, 25%, 50%, 75%, 90%) as factors, and randomized four times within them. Data on seed yield from each of two locations were taken. All the data were analyzed using SAS 9.3 software. For both stem cut-off and stand reduction, seed yields decreased with increasing plant development and intensity of stand reduction or stem cut-off. The highest yield loss was found at 90% stand reduction at 90% flowering growth stage that reduced the seed yield by 82%. Across growth stages, 90% stand reduction and stem cut-off resulted in seed yield losses of 64.7% and 16%, respectively. Additionally, 90% flower resulted in a yield loss of 43% and 22.2% across levels of intensity for stand reduction and stem cut-off, respectively. Stem cut-off was found to have less of an effect on seed yield compared to stand reduction.

Support: Northern Canola Growers Association

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**POSTDOCTORAL, FACULTY, AND PROFESSIONAL COMMUNICATIONS**

(Communications are listed alphabetically by the last name of the presenting author)



## CAN INTERTIDAL GEOMETRY SELECT? STEPS TOWARD UNDERSTANDING A CRYPTIC PULSE OF TERRESTRIALIZATION

Joseph H. Collette\*, Ana Swor‡, and Jesse Dalle‡

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The transition of marine life into terrestrial environments may have taken place 500 million years ago – significantly earlier than classical notions suggest. It has been posited that during this interval selection pressures associated with very broad intertidal zones may have prompted development of novel strategies or structures allowing animals to move ashore. However, while some studies have documented subaerial animal traces of this age, few details are known about these environments – including such basic information as the slope of the sea floor across which these forays commenced. As a preliminary step toward addressing these questions, a detailed survey of nearshore sandstones of this age was conducted in Wisconsin in 2016. That study found the average nearshore slope to be  $0.27^\circ$  and estimated the width of the intertidal zone to be 0.42-0.48km.

The sandstones in this study are glacial outliers; thus it is possible, even likely, that multiple glacioisostatic episodes have altered original bedding orientations. To address this question, several thousand ripple marks – primary sedimentary structures whose orientations are not altered by isostatic adjustment – were surveyed in 2018 to estimate paleodepth and bedding plane slopes. Preliminary ripple-estimated results are consistent with bedding plane geometry results suggesting that isostatic forces from multiple Quaternary glaciations did not significantly alter original bedding plane orientations as preserved today.

Support: J. Dalle was supported by AAPG L. Austin Weeks Undergraduate Research Grant and the MSU Geology Department's Bob and Kathy Mau Undergraduate Student Research Grant.

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## DESIGN OF POROUS CARBONACEOUS FOAM FROM LIGNIN

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Kathryn Hall<sup>1</sup>, Yun Ji<sup>1</sup> and Scott Payne<sup>2</sup>

*1. University of North Dakota and 2. North Dakota State University*

We report the synthesis and characterization of lignin-based foams by pyrolyzing cold pressed lignin compacts and its composites with wheat straw and sugar beet pulp at 300 oC, 500 oC, 700 oC, and 900 oC in Ar atmosphere. These compositions were studied by detailed TGA, TMA, FTIR, and microstructure analysis. A combination of SEM and X-ray tomography analysis showed that all the foams had cellular structure. In addition, the morphology of porous structure become more controlled by the addition of Wheat straw fibers. Detailed SEM and EDS analysis showed that we are forming Si-rich nanostructures. Furthermore, careful analysis of FTIR results showed a decreased in intensity of peaks for all the samples fabricated at higher temperatures which was further correlated with changes in lignin molecular structure. Finally, by analyzing TGA, TMA, FTIR, and microstructure, a novel mechanism for designing lignin based cellular solids by reinforcing it with biofibers has been proposed in this work. It is expected that these foams can be used for multifunctional applications.

Support: NSF EPSCoR and Dean Professorship to Prof. Surojit Gupta

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**PROCEED WITH CAUTION!**  
**REGULATION OF A COMPONENT CRITICAL FOR THE CELLULAR RESPONSE TO DNA  
DAMAGE**

Stuart J. Haring\* (1,2), Timothy M. Wilson (1), Angela M. Adsero (2), Trevor A.  
Baumgartner (1), Wendy A. Larson (1), Erin M. Richards (1), and Cristian A.  
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*(1) Chemistry and Biochemistry and (2) Interdisciplinary Cellular and Molecular Biology  
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Background: Entry into cell cycle arrest (i.e., checkpoint) is critical for how cells handle putative mutation-causing DNA lesions; however, eventual checkpoint exit must occur for cells to continue growing. Two types of exit have been identified: (1) checkpoint recovery - exit from a checkpoint after lesion repair and (2) checkpoint adaptation - exit from a checkpoint prior to lesion repair. While recovery would appear to be the preferred cellular response, one instance where adaptation would be preferred (at least by the cell) is when the lesion cannot be repaired. One factor that interacts with checkpoint proteins, is post-translationally modified in response to DNA damage, and is required for checkpoint entry is Replication Factor A (RFA).

Hypothesis: RFA in yeast is phosphorylated in response to DNA damage in order to regulate checkpoint timing.

Results and Conclusions: We have identified a novel, additional "late"-occurring phosphorylation event that dictates checkpoint exit (adaptation). This late phosphorylation requires the Rfa2 N-terminus (NT), and we have demonstrated that mimicking phosphorylation or driving natural phosphorylation of the Rfa2 NT promotes checkpoint adaptation, whereas non-phosphorylatable Rfa2 NT mutants prevent or even further inhibit checkpoint exit. We propose a model where phosphorylation of the Rfa2 NT is a major (and perhaps THE major) signaling event that drives exit from a checkpoint, especially following irreparable DNA damage.

Support: This work was supported by NSF-CAREER-1253723 to SJH.

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Kim  
Faculty  
Talk

## **PERIVASCULAR "RE-INVESTMENT" :NEW CONCEPT OF VASCULAR NORMALIZATION**

Jiha Kim\*, Sangdeuk Ha, Alexander Delgado

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In pancreatic cancer (PC), most conventional and targeted therapies fail to provide substantial response mainly due to the limited delivery efficacy of cytotoxic drugs. Poor vascular structure and stroma-rich tumor microenvironment (TME) likely contribute to such failure. We have previously shown that in breast cancer, differential perivascular investment significantly impacts vascular functionality and drug delivery efficacy. Considering unique pancreatic cancer TME, it is a promising approach to "re-invest" perivascular cells in which blood vessels are in their optimal functional status.

As a first attempt to understand perivascular phenotype of Pancreatic tumors, we utilized Multiplex imaging analysis technique to map out differential pericyte markers expression on several Mouse Model systems for PC as well as Tumor MicroArray (TMA) of patients with PC. Among pericyte markers examined, Alpha-Smooth Muscle Actin (a-SMA) expression was significantly increased in all cases of PC compared to normal Pancreas tissues which skewed the ratio between Desmin (mature pericyte marker) and a-SMA. We also confirmed that such differential expression could be achieved in the presence of PC cells in vitro pericyte co-culture system. Currently, we are investigating the molecular mechanism that influence abnormal tumor-associated pericyte phenotype in an attempt to revert it to the normal status. Such a finding will contribute to vascular normalization and enhanced vascular performance.

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## GENETIC AND GENOMIC DISSECTION OF CANOLA ROOT ARCHITECTURE

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Rapeseed/canola (*Brassica napus* L.) root system varied widely among the winter and spring growth habit types. The winter type has a vigorous root system whereas the spring type has a weakly developed root system. Genetic study on root vigor identified three major dominant genes control the vigorous root system in rapeseed/canola. A genome-wide association study was conducted using 224 diversified *B. napus* germplasm accessions. A total of 37,500 and 30,262 SNP markers were used to detect marker trait association in the greenhouse and in the field studies, respectively. Fifty-two and thirty-one significant markers were identified for different root traits in the greenhouse and field, respectively. A total of 37 candidate genes related to root architectural traits were identified within the close proximity of different significant markers. Three of these markers were identified within the candidate genes, P-glycoprotein 6 (PGP6) for root hair elongation, Tetraspanin 7 (TET7) for root morphogenesis, ARABIDILLO-2 for lateral root development, respectively. Cryptochrome 2 (CRY2) for root development, Cyclin-dependent kinase 2;3 (CYCA2:3) for lateral root formation, and several other genes related to auxin activated signaling pathway, gibberellic acid mediated signaling pathway, cytokinin-activated signaling pathway, ethylene-activated signaling pathway, root meristem specification were identified. This is the first report on root system architecture in *B. napus*.

Support: Northern Canola Growers Association

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## REDUCE GRAPHENE OXIDE/AG NANOCOMPOSITE TO ENHANCE SYNERGETIC ANTIBACTERIAL CAPACITY

Xu Wu, Shirui Tan, Yuqian Xing, Sam Lilak, Min Wu, Julia Xiaojun Zhao

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*Laboratory of Biochemistry and Molecular Biology, School of Life Sciences, Yunnan University, Kunming 650091, China*

Nanotechnology has shown promising potential for the treatment of bacterial infections due to the emergence of multidrug-resistant (MDR) bacterial strains. Silver nanoparticles and graphene-based nanomaterials are two major types of nanomaterials that are used to inhibit and/or kill bacteria. In this study, by combining the excellent photothermal effect of graphene and antibacterial activity of silver nanoparticles, we constructed a reduced graphene oxide/silver nanoparticle (RGO/Ag) nanocomposite using glucose as the environmental-friendly reducing agent for killing the MDR bacteria. The antibacterial activity of RGO/Ag nanocomposite was carefully investigated using *Escherichia coli* (*E. coli*) and *Klebsiella pneumoniae* (*Kp*) as bacterial models. We found that, compared with AgNPs, graphene oxide (GO) and RGO, RGO/Ag nanocomposite had higher antibacterial efficiency. Under the near-infrared (NIR) irradiation, RGO/Ag nanocomposite demonstrated enhanced synergetic antibacterial activity through the photothermal effect. Almost 100 % of *E. coli* and *Kp* were killed by the treatment of 15  $\mu\text{g/mL}$  and 20  $\mu\text{g/mL}$  of RGO/Ag nanocomposite, respectively, with NIR irradiation. Moreover, the membrane integrity assay and ROS species assay demonstrated that RGO/Ag nanocomposite under NIR irradiation caused the cell membranes disruption and generation of ROS species, providing the possible mechanisms for their high antibacterial activity besides photothermal effect.

Support: This work was supported by the NSF grant CHE 1709160 (J.X.Z.), North Dakota Industrial Commission (G-041-081, J.X.Z.), UND Vice President for Research & Economic Development Postdoctoral Funding Program (J.X.Z), and Applied Research to Address the State's Critical Needs Initiative program (X. W.).

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**POSTER COMMUNICATIONS**

Darland  
Faculty  
Poster

## **THE EFFECT OF EMBRYONIC COCAINE EXPOSURE ON LONGITUDINAL GENE EXPRESSION, BEHAVIOR AND PHYSIOLOGY**

Tristan Darland, Brook M. Jensen , Hannah G. Johnson, and Cody Boyle

*University of North Dakota, California State University Stanislaus, College of Saint Benedict, and University of North Dakota School of Medicine and Health Sciences*

Our lab is interested in the longitudinal effects of toxin exposure experienced during early brain development. Zebrafish provide a convenient model system because they can be easily treated with toxins during development, can be raised rapidly and efficiently to adulthood, and can then be assessed for several behaviors and physiological responses. In this study we exposed zebrafish to cocaine during early brain development and assessed resulting gene expression and behavioral changes later in adulthood. In previous a transcriptomic study, one gene, neurexin3a (nrxn3a) showed a dramatic longitudinal change in adult brain expression after earlier pre-exposure to cocaine. This gene, encoding a synaptic protein particularly prevalent in the striatum, may provide a future target for pharmaceutical intervention of addiction and other mental disorders. The present study was meant to validate the previous data and correlate the gene expression changes with differences in behavior and physiology. The correlates include behavioral sensitivity to cocaine in a conditioned place preference (CPP) assay and visual acuity using the optokinetic reflex (OKR).

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Munski  
Faculty  
Poster

## **HERITAGE TOURISM PLANNING FOR THE NEAR NORTH NEIGHBORHOOD OF GRAND FORKS, NORTH DAKOTA**

Douglas C Munski  
Lori Young  
Laura B Munski

*University of North Dakota  
University of North Dakota  
Dakota Science Center*

Community development increasingly involves heritage tourism in the Near North Neighborhood of Grand Forks, North Dakota. This type of cultural amenity-oriented tourism increasingly is using waypointing to inform people about local history and geography in this Mayors Urban Neighborhood Initiative area of the city. Starting in the summer of 2016, waypointing materials have been created for the Near North Neighborhood. Such work has been intensified in the spring of 2019 with the involvement of University of North Dakota undergraduates as part of a service learning course that is creating an updated historic landmarks brochure and a set of posters featuring specific locations within the Near North Neighborhood. This current collaboration also involves the Near North Neighborhood Association, Dakota Science Center, Augustana Lutheran Church, and members of the Grand Forks Historic Preservation Commission. This particular poster is focused upon presenting the methodologies used to investigate the assorted sites in this neighborhood. It also highlights preliminary results of the GEOG 300 course in terms of products for the use of tourists. An end result of this phase of research is anticipated to encourage local and regional tourism. Crucially, it will provide a better understanding of a corridor that can be studied emphasizing the historical geography of a neighborhood connecting the Riverside Park Historic District with the Downtown Grand Forks Historic District.

Support: Virginia George Inheritance Fund

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## OPTIMIZATION OF SUGARBEET WASTEWATER TREATED USING ELECTROFENTON METHOD

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Processing and washing of sugarbeet for the production of sugar creates a large amount of wastewater that contains high concentration of chemical oxygen demand (COD) consisting mostly organic carbon compounds. In this study, electrochemical peroxidation (ECP), a variant of electrofenton (EF) process, was adopted to treat the primary effluent of the sugarbeet processing industry. The effects of H<sub>2</sub>O<sub>2</sub> dosage, current density and operation time were investigated using Box-Behnken design (BBD), a response surface methodology (RSM) and a set of 15 experimental run were conducted for optimization of operating parameters. Quadratic regression models with estimated coefficients were developed to describe the removal of organic pollutants. The results showed that ECP could remove total and soluble COD and total and dissolved organic carbon by 65%, 67%, 63% and 65% respectively at optimum conditions of H<sub>2</sub>O<sub>2</sub> dosage of 24 ml/L, current density of 59.8 mA/cm<sup>2</sup> and operation time of 304 min. The predicted values were in reasonable agreement with observed values.

Support: Funding for this research was provided by North Dakota Agricultural Experiment Station.

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## EFFECTS OF HAZELNUT SKIN ON BREAD QUALITY AND NUTRITIONAL PROPERTIES OF SOURDOUGH BREAD

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*(2) Department of Food Engineering, College of Engineering, Ondokuz Mayıs University,*

*Samsun, Turkey and (3) Department of Plant Sciences, North Dakota State University, Fargo, ND 58108-6050, USA*

Sourdough bread baking is one of the oldest baking methods. Lactic acid bacteria (LAB) and yeast are two organisms that are essential for sourdough fermentation. Sourdough fermentation can improve some features of bread, such as flavor, volume, shelf-life, nutritional value, biochemical activity via high microbial activities of both yeast and LAB. These attributes are also related to the dietary fiber content of the bread. In this study, hazelnut skin (0, 5 and 10%) was used as a dietary fiber source in sourdough bread production. The aim of this study was to examine the effects of hazelnut skin on bread quality and nutritional properties of sourdough bread. The farinograph stability values significantly ( $p < 0.05$ ) increased due to addition of hazelnut skin. Gas production was significantly ( $p < 0.05$ ) reduced by increasing levels of hazelnut skin. Determination of starch pasting properties is important for final bread quality. High peak viscosity indicates higher water retention and granule swelling capability of starch and peak viscosity was found to be highest in 0% hazelnut skin samples (1096.50 cP). Sourdough bread samples were examined for in-vitro starch digestibility. Bread samples with hazelnut skin showed lower rapidly digestible starch and estimated glycemic index (eGI) but higher resistant starch content compared to the control with no hazelnut skin. Sourdough bread with hazelnut skin can be considered as a product with improved quality and nutritional properties.

Support: : No financial support was provided to SJH or BS for this work.

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**APPLYING A NEW METHOD FOR THE QUANTIFICATION OF PREDATION BY D. DISCOIDEUM ON SOIL-ISOLATED E. COLI**

Reid G. S. Hawkins\*(1), Alexandra Arroyo(1), Kaycie N. Schmidt(1), Peter W. Bergholz(1)

(1) *Microbiological Sciences, North Dakota State University, Fargo, ND*

*Escherichia coli* is a genetically diverse species of bacteria notable for its presence in the healthy gut flora and its pathogenic subtypes responsible for foodborne diseases and urinary tract infections. *E. coli* can survive for extended periods in non-host environments, like soil, and it is thought that predation pressure from protozoa may select for virulence. Predation from the amoeba *D. discoideum* depends upon an engulfment mechanism similar to that of human macrophage. Thus selection for resistance to predation may also enhance resistance to the human immune system. The signal of selection for predation resistance may be detected using a genome-wide association study (GWAS). A chief requirement for GWAS will be high quality measurements of predation resistance. Past studies have used plaque formation on microbial lawns and feeding distances along streaks of bacteria to describe predation phenotype. Plaque scoring offers low resolution and distance measures may also measure predator preference and prey resistance due to plate design. Plating streaks in parallel and measuring phenotypes as the ratio of feeding distance on a test streak to a control avoids these issues. This novel technical adjustment has been applied to a subset of 12 soil-isolated strains using a commensal control to produce repeatable data ( $R = 0.344$ ,  $SE = 0.175$ ). The method enhanced throughput and accounts for biological and technical variation among replicates using a control strain of *E. coli*.

Support: This work was supported by NSF-1453397 to PWB.

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Jin  
Graduate  
Poster

## **SORPTION BEHAVIOR OF CATIONIC AND ZWITTERIONIC POLYFLUOROALKYL SUBSTANCES ON FIVE SOILS**

Bosen Jin, Feng Xiao

*Department of Civil Engineering, University of North Dakota*

Per- and polyfluoroalkyl substances (PFASs) refer to a large group of fluorinated organic chemicals. In the 1940s, 3M produced the first perfluoroalkyl substance: Perfluorooctanoic acid (PFOA). Since then, more and more PFASs were produced and widely utilized in both industries and daily lives, like Aqueous Film Forming Foam, non-stick pans, and waterproof clothes. However, in the 1990s, the toxicity of PFASs was confirmed, and US EPA started to set up the regulations for PFASs, especially for those so-called “legacy PFASs.” Recently, many emerging poly-PFASs were produced to substitute those legacy per-PFASs. Nonetheless, the toxicity, the physiochemical properties and the transport and fate of the emerging poly-PFASs were still unknown, and there are still gaps among EPA’s regulations upon the emerging PFASs.

In this study, the sorption behaviors of PFOA and its two precursor compounds, perfluorooctaneamido betaine (PFOAB, zwitterionic) and perfluorooctaneamido ammonium salt (PFOAAmS, cationic) were studied by using batch test on five different soils. The mechanisms of adsorption ability and desorption hysteresis were well-developed by investigating the soil properties and soil-buffer system.

Support: UND VPR’s New Faculty Early Career Award Program

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Kadioglu  
Graduate  
Poster

## **SHALLOW WATER TABLE EFFECTS ON YIELD AND QUALITY PARAMETERS OF CANOLA (BRASSICA NAPUS)**

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Fargo, ND, USA*

Water table contribution to plant water use is a significant element in crop production since it reduces the drainage and irrigation water volume and enhances the crop water uptake from groundwater. In this study, responses of canola (*Brassica Napus* L.) plant water uptake, crop growth and yield parameters to three constant water table depths of 30, 60, and 90 cm were studied under a controlled environment using lysimeters. Canola plant's tolerance level to shallow groundwater were determined through soil profile. The highest and lowest seed weights per plant were found as 6.74 and 4.12 gr in 90 cm and 30 cm of water table depths, respectively.

Support: Funding for this research was provided by the North Central Region Canola Research Program and North Dakota Agricultural Experiment Station.

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Lee  
Graduate  
Poster

## **DEVELOPING A FACILITIES ASSET MANAGEMENT SYSTEM**

Eohjin Lee\*, Brian Larson\*\*, and Bradley C. Rundquist\*

*\*Department of Geography & GISc*

*\*\*Facilities Management*

UND Facilities Management currently uses AutoCAD for managing building floor plans and space allocations among academic departments and service units. AutoCAD is useful to design construction projects, but it is limited in its lack of web-based interface and website availability, primarily because CAD does not have support to place its actual position on maps displayed by websites. GIS has a wide spectrum of applications that may be useful for space management. One of the advantages of GIS is its ability to include spatial reference from the AutoCAD drawing files, and this is the key to resolving the most challenging aspect of limited CAD functions. The demand for Web GIS professionals who can organize and present data to facilities managers and business officers will continue to grow as more administrators are looking to better understand building space utilization.

Support: UND Facilities Management

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O'Denius  
Graduate  
Poster

## **AN EFFICIENT AND VERSATILE MANGANESE CATALYST FOR THE HYDROBORATION OF CARBONYL COMPOUNDS**

Srikanth Vijjamarri, Timothy O'Denius, and Guodong Du.

*NDEPSCoR, UND chemistry*

A manganese salen complex is shown to be an effective catalyst for hydroboration of ketones and aldehydes at room temperature conditions with high functional group tolerance. Green chemistry is presented through low catalyst loading of our earth abundant and inexpensive base metal. The hydrolyzed product of the borate ester is readily obtained under mild conditions. Further kinetic and mechanistic studies as well as additional functional group tolerance is under investigation in our lab.

Support: NDEPSCoR, UND chemistry

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Spiess  
Graduate  
Poster

## **A HAILSTORM REDUCED FORAGE, NESTING COVER, AND FLORAL RESOURCES IN SOUTHWESTERN NORTH DAKOTA**

Jonathan Spiess\* (1), Jasmine Cutter (2), Devan McGranahan (2), Ben Geaumont (3), Torre Hovick (2)

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An overlooked impact of anthropogenic climate change on grasslands is greater frequency and severity of hailstorms associated with rising minimum temperatures. Although often more spatially-discrete than management actions like grazing and fire, these natural disturbances are much less predictable and can occur in the middle of the growing season. A set of experimental pastures and hay fields in southwestern North Dakota were hit by a hailstorm shortly after they were sampled in the summer of 2018. We repeated transects in hail-struck sites to quantify loss of vegetation structure and floral resources, important to grassland birds and pollinators, respectively. We measured vegetation structure using visual obstruction readings to approximate forage and nesting resources and measured flowering stems along pollinator survey transects, respectively. Structure was reduced by 48% across three sites and floral stem counts were reduced by 77% in the cattle pasture. The structure reduction represents a loss of quality forage resources for grazing animals and hay production and altered nesting cover for grassland wildlife. Fewer flowering stems is especially concerning given the paucity of forbs in low diversity grasslands in southwestern North Dakota. Our data underscores the value of landscape-level heterogeneity at a scale broader than localized storm events to ensure redundancy of resource provisioning as the frequency of extreme weather is expected to increase.

Support: This research was supported by the Hettinger Research Extension Center.

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Young  
Graduate  
Poster

## **ASSESSING GEOG AT THE UNIVERSITY OF NORTH DAKOTA FOR SCHOLARSHIP OF TEACHING AND LEARNING**

Lori J Young  
Douglas C Munski n

*GEOG & GISc, University of North Dakota*

GEOG 161 is a basic world regional course at the University of North Dakota. It fulfills several of the Essential Studies requirements at this campus, particularly as a social science course designated as fulfilling a Global Diversity Essential Studies Requirement. The assessment was comprised of 35 multiple-choice questions selected from the course textbook test bank, i.e., *Geography: Realms, Regions, and Concepts* (17th Edition). Questions involved both content knowledge and the use of maps, charts, and graphs. The systems used to classify questions include Bloom's Taxonomy and the National Geography Standards. Students took the pre-test on Day One of Sp18. The post-test was administered during the last class of the semester. There may have been students who missed one of the testing events for various reasons, including adding the course after the initial survey had been administered, or dropping the course after taking the first test. Results from the pre-test and post-test are presented using this poster. Because the pretest and post-test will be repeated in the future to gauge student learning, the survey instrument needs to be revised so that more of the questions meet being classified from Bloom's higher levels of thought. Considering that this is an Essential Studies course, more complex levels of learning and thinking should be emphasized rather than the lower knowledge and comprehensive levels. Such is the intention in curriculum revisions starting in Su19.

Support: Virginia George Inheritance Fund

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Wang  
High-School  
Poster

## **FRATAXIN DEFICIENCY AFFECTS RESPIRATORY SUPERCOMPLEXES FORMATION AND GLYCOLYSIS IN FRIEDREICH ATAXIA**

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**Abstract:** Friedreich's ataxia (FRDA), an inherited, progressive neurodegenerative disease, is caused by a reduced expression of the mitochondrial iron-binding protein, frataxin. To study the pathophysiological mechanism of how frataxin deficiency causes the devastating disease, we created a cellular model of FRDA by stably knocking down frataxin in glioma LN428 cell line. The expression level of frataxin in several cloned knockdown cell lines was about 10% of that of control. Both OXPHOS and glycolysis were significantly down-regulated in frataxin knockdown cells. Reduction in these two bioenergetic pathways reduced steady-state ATP levels. Fe/S containing subunits in complex I, II and III were decreased in response to frataxin deficiency, which affected the assembly of complexes and the formation of supercomplexes. The activities of aconitase were also reduced in response to frataxin deficiency. PDK1, a protein kinase that phosphorylates and thus inactivates pyruvate dehydrogenase alpha subunit, was overexpressed in frataxin knockdown cells. Thus, at three key steps of respiration, including pyruvate entry into TCA cycle, the TCA cycle and OXPHOS, cells down-regulated their activities in response to frataxin deficiency. We conclude that down-regulation of bioenergetics is an important mechanism for the pathological development of Friedreich ataxia, and that patients with FRDA may suffer from a bioenergetic crisis with an increased demand for ATP.

**Support:** Part of the study was completed at NDSU Center for Protease Research Core Biology Facility that is supported through NIH Grant P30 GM103332-01

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Guo  
Postdoc  
Poster

## **VENNDETAIL: AN R PACKAGE FOR VISUALIZING AND EXTRACTING DETAILS OF MULTI- SET INTERSECTION**

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Visualization and information extraction of shared and unshared sub-sets of multiple datasets, such as genes, proteins, organisms as well as other entities, are a common task in bioinformatics analyses. Although various R packages and web applications are available for generating Venn diagrams, no convenient R package enabling users to extract sub-set information, to highlight the sub-sets of interest on diagrams and to combine the details of these sub-sets with the original datasets in an R data frame. We have developed VennDetail (<https://github.com/hurlab/VennDetail>), an R package to generate high-quality Venn-Pie charts and to allow extraction of sub-set details from up to eight input datasets. We also created a shiny web application (<http://hurlab.med.und.edu/VennDetail/>) for those who are not familiar with the R analysis platform. In conclusion, the VennDetail package introduces a novel and convenient way to display Venn diagrams and extract sub-set details from multiple datasets.

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Ray  
Postdoc  
Poster

## **A NOVEL ROLE FOR THE TRANSCRIPTION FACTOR SNAIL IN ALTERNATIVE SPLICING**

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The transcription factor SNAIL is a key regulator of the first step of cancer metastasis, Epithelial to Mesenchymal Transition. This process is characterized by a cell-state shift from the highly differentiated epithelial phenotype to the less differentiated migratory mesenchymal phenotype. SNAIL binds to E-box motifs in promoter regions and recruits chromatin remodelers to repress or activate gene expression.

Mass spectrometry, immunofluorescence, and co-immunoprecipitation data from our lab indicate that SNAIL associates with splicing protein SRSF1. Co-immunoprecipitation performed after RNase treatment indicated that the association was lost, suggesting SNAIL-SRSF1 association is RNA-dependent. RNA Immunoprecipitation followed by PCR, as well as rEMSA data, suggest that SNAIL binds to RNA, specifically to the IIIc exon of FGFR1, a protein known to be alternatively spliced. Because SRSF1 is a known regulator of alternative splicing, we hypothesize that SNAIL regulates alternative splicing by binding to RNA and recruiting SRSF1. We further predict that because transcription and splicing are closely coupled, transcription factor regulation of splicing through RNA binding is universally utilized by other biological systems to alter phenotype in response to external stimuli. We are currently investigating genome-wide changes in alternative splicing regulated by SNAIL, and the associated mechanism by which SNAIL interaction with the spliceosome leads to alternative splicing.

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Hill  
Professional  
Poster

## **TO GLIA OR NOT TO GLIA: CORTICAL STEM CELL FATE INFLUENCED BY VASCULAR CELLS**

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During forebrain development, vascular ingression coincides with cortical neural stem cell (NSC) differentiation into neurons and glia. There is a gap in our understanding of the regulatory interactions occurring between NSC and the vasculature. Our working hypothesis is that NSC differentiation is dependent on vascular cell-derived Leukemia inhibitory factor (Lif) and Vascular endothelial growth factor (Vegf). We tested our hypothesis using a heterotypic cell culture system to mimic the cellular microenvironment of developing mouse forebrain. Embryonic day (E) 13.5-derived NSC are cultured on one side of a Transwell membrane with brain microvascular-derived perivascular and endothelial cells grown on the opposite side of the membrane. In the presence of vascular cells, NSC express Glial fibrillary acidic protein (Gfap) and Fatty acid binding protein 7 (Fabp7), which are associated with the glial lineage. The results suggest that vascular-derived factors direct cell fate towards gliogenesis. We quantified Lif and Vegf in NSC solo and coculture with brain-derived vascular cells. While NSC, themselves, do not express Lif, the perivascular cells, when grown in coculture with endothelial cells or NSC, express Lif RNA and produce Lif protein. In contrast, the NSC and vascular cells both express Vegf when cultured alone, but levels increase when the cells are cultured together. These findings support a vascular cell signaling-dependent mechanism for directing NSC differentiation.

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Munski  
Professional  
Poster

## **EXPANDING NASA'S DIGITAL ENVIRONMENTAL WATCH IN WALSH AND PEMBINA COUNTIES, NORTH DAKOTA**

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Douglas C Munski

*Dakota Science Center  
University of North Dakota*

Science, technology, engineering, and mathematics (STEM) projects are important to the K-12 schools associated with the North Valley Career and Technology Center (NVCTC) of Grafton, North Dakota. Yet, citizen science activities in those schools also are diffused into the local communities. Of particular interest is the National Atmospheric and Space Administration Digital Environmental Watch (NASA DEW). This is dynamic citizen science outreach involving the Dakota Science Center (DSC). It emphasizes collecting local data to send to NASA concerning small-scale environmental change. The object is to apply basic remote sensing ground-truthing at low-cost and to promote enthusiasm in STEM-based environmental studies. Data collection is easy and simple. Participants go to posts identified by latitude/longitude that have a plastic post cap and that identifies cardinal and intermediate compass directions. The citizen scientists then take a digital photograph along those compass bearings. They also provide a straight-up view from the post for reporting current sky conditions. Finally, the data is uploaded to a repository. This archive is at the University of New Hampshire-hosted NASA DEW website. By collaborating with the NVCTC, the DSC is promoting adoption of the project in both schools and local park districts in Walsh County and Pembina County. Thus, there is an expansion of people as citizen scientists in the diffusion of NASA DEW in this part of northeastern North Dakota.

Support: Virginia George Inheritance Fund

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Barker  
Undergraduate  
Poster

## **KINETIC MODELING OF SUBSTRATE INHIBITION OF ALDH2 AT PHYSIOLOGICAL CONCENTRATIONS OF MAGNESIUM ION**

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Accumulation of reactive aldehydes plays a role in cellular oxidation damage and mitochondrial aldehyde dehydrogenase (ALDH2) mediates the detoxification of these reactive aldehydes. The presence of magnesium ions has been shown to influence ALDH2 activity by enhancing the apparent rate of deacylation and increasing NADH binding affinity. Our studies have indicated that the presence of magnesium ion induces partial substrate inhibition of ALDH2 by simple straight-chained aldehydes. Our goal is to elucidate the substrate inhibition mechanism and determine if abortive complex formation plays a significant role.

Enzyme activity and abortive complex formation was evaluated by applying time-resolved fluorescence spectroscopy on the ALDH2 system to resolve the mixture of fluorescent signals coming from free NADH, enzyme bound NADH, and aldehyde-NADH-ALDH2 complex. Kinetic modeling was performed using DynaFit to address the partial substrate inhibition.

The kinetic results indicate that there are two different substrate inhibition mechanisms present in the straight-chained aldehyde ALDH2 system. In the absence of magnesium ion, competitive inhibition appears to be significant. In the presence of high magnesium ion concentration, uncompetitive inhibition appears to be dominant.

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## **SENSITIZING AML CELLS TO DIFFERENTIATE WITH ATRA**

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Human acute myeloid leukemia (AML) is associated with recurrent chromosome translocations, which create oncoproteins that block differentiation and promote proliferation of myeloid cells. The Myeloid Lymphoid Leukemia gene (MLL) is frequently involved in these translocations and is considered a driver of AML. Differentiation promoting drugs, such as all-trans-retinoic acid (ATRA), are an attractive alternative to cytotoxic chemotherapy, but few types of AML respond to ATRA. We hypothesize that specific genes must be activated or inhibited in AML for ATRA to induce differentiation. Our initial studies focused on two AML cell lines, MV4;11 and THP-1, with alterations in the MLL gene, and one non-MLL related AML cell line, U937. The cells were treated with epigenetic modifiers, including tranylcypromine (TCP), N-acetyl-dinaline (CI-994), and 3-deazaneplanocin A (DZNep) to alter global gene expression. Multiple parameters were examined to monitor myeloid differentiation. By all measures, all three drugs seemed to sensitize U937 and THP-1 cells to differentiate when treated with ATRA. MV4;11 cells showed partial differentiation with ATRA when treated with CI-994 or DZNep. These experiments suggest epigenetic inhibitors may alter gene expression to increase sensitivity to ATRA differentiation therapy, but the response may still be dependent on the specific gene alteration driving the AML.

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Hunt  
Undergraduate  
Poster

## **SURVEY OF TICK BLOOD MEALS AND ASSOCIATED BACTERIAL DIVERSITY**

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Ron Royer, Paul Lepp

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The hard-bodied tick *Ixodes scapularis*, also known as the black-legged or deer tick, is the vector primarily responsible for the transmission of the bacterium *Borrelia burgdorferi*, the etiological agent of Lyme disease. Both *Ixodes scapularis* and the accompanying bacterial pathogen *Borrelia burgdorferi* have been slowly and steadily moving westward from the east coast of North America towards the interior plains region, reaching as far west as the Red River Valley where there have been sporadic reports over the past decade. The reservoir for *Borrelia burgdorferi* and the most common host for *Ixodes scapularis* in the eastern U.S. is the white-footed mouse, *Peromyscus leucopus*. The population density and distribution of *Peromyscus leucopus* on the Great Plains is much smaller than in the east, however, due to habitat restriction. While it is speculated that *Peromyscus leucopus* is the primary reservoir for *Borrelia burgdorferi* on the plains there is little evidence to support this hypothesis. We used PCR to survey hundreds of individual ticks in order to identify the mammalian host blood meal in an attempt to determine the most common host for *Ixodes scapularis* on the plains. In addition, we used nanopore, real-time sequencing to determine the bacterial diversity harbored by these same individual ticks.

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Lilleboe  
Undergraduate  
Poster

## **IMPACT OF VARIOUS ORGANIC SOLVENT RATIOS IN WATER ON SOLUBILITY OF ALKALI LIGNIN**

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Lignin is an organic macromolecule that is found within plant cell walls and is currently recovered as a waste product in the paper industry and combusted for energy. Lignin has a potential for being a renewable resource if broken down into monomers and oligomers. The solubility of alkali lignin in organic solvents alone and with water in various ratios was tested in this study. The extraction efficiencies of different solvent systems were initially investigated by gravimetry. The optimal solvent systems proved to be aprotic solvents with water, which produced high percent recovery for both lignin and solvent. In contrast, solvent systems containing alcohol, with and without water, displayed poor recovery percentages for both lignin and solvent. Thermal carbon analysis (TCA) was used to thermally distinguish the fractions of monomeric, oligomeric, and tar-like polymer species within the solid and liquid samples. In future work, detailed characterization of both solid and liquid fractions will be accomplished using thermal desorption-pyrolysis-gas chromatography-mass spectrometry.

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Mikhova  
Undergraduate  
Poster

## EFFECTS OF METHAMPHETAMINE ON ADRENAL CELLS

Mariia Mikhova\* and Bryan Schmidt

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Methamphetamine is a known central nervous system stimulant and widely abused illicit drug. Despite the well-described effect of methamphetamine on brain activity, the classic side effects of methamphetamine abuse suggest a role in peripheral tissue as well. These side effects include vasoconstriction, tachycardia, appetite suppression and weight loss, all of which are also results of epinephrine stimulation. To test the correlation between exogenous methamphetamine and epinephrine production, cultured adrenal cells were treated with either acetylcholine, cortisol, methamphetamine or a combination of acetylcholine, cortisol and methamphetamine. Epinephrine excreted from the cells was quantified with ELISA of the cell culture media. Cell growth rates and cell viability were both measured for ten days following treatment. Stimulation with methamphetamine, alone or in combination with acetylcholine and cortisol, decreased the cell viability. These data suggest an interaction between methamphetamine and epinephrine-producing adrenal cells, though the exact nature of this interaction still needs to be determined.

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Olson  
Undergraduate  
Poster

## **METHOD OPTIMIZATION FOR EXTRACTION AND ANALYSIS OF CATECHOLAMINES ADRENAL CELLS USING GC/MS**

Eric W Olson\*, Matthew R Winburn, Naomi R Winburn, Bryan J Schmidt

*Minot State University*

Methamphetamine and epinephrine have very similar effects when in the body. The similarities in symptomology lead to the hypothesize that there is a connection between these two catecholamines. That connection could be between levels of epinephrine and/or norepinephrine (from which epinephrine is derived) in the body. To test this hypothesis a cultured adrenal cell media will be used because of the ethical issues of testing methamphetamine on humans. In order to be able to test for the catecholamines on GC/MS (gas chromatography/ mass spectroscopy) a method must be developed for the extraction of the catecholamines from the cell media using an extracting solvent. For the analysis a method will be developed, and parameters will be optimized to analyze the extractant. All GC/MS analysis for this study will be performed on a Thermo Scientific Trace GC Ultra gas chromatograph in tandem with a Polaris Q mass spectrometer.

Support: Institutional Development Award (IDeA) from the national institute of General Medical Sciences of the National Institutes of Health under grant number P20GM103442.

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Solberg  
Undergraduate  
Poster

## **SOCIAL INTERACTIONS OF TRANSLOCATED AMERICAN BISON (BISON BISON) AT THEODORE ROOSEVELT NATIONAL PARK**

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(1) *Biology, University of North Dakota, Grand Forks, ND*

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American bison (*Bison bison*) were hunted almost to extinction in the 1880s with less than 1000 individuals remaining. Conservation efforts increased populations to more than 500,000 bison today. Theodore Roosevelt National Park manages a bison herd within a fenced enclosure. Translocations of other individuals into the herd are used to promote genetic diversity. In 2017, 10 females were translocated from Badlands National Park and were fitted with GPS/VHF collars upon arrival. Ten resident females were also collared. While collars provide important information on movement, they do not provide information on social interactions, especially when only a subset of the resident population is marked. Therefore, our primary objective was to document if aggressive and reproductive behaviors occurred between residential and translocated bison in the North Unit of Theodore Roosevelt National Park in Western North Dakota. We conducted 33 focal and 17 scan behavioral observations on bison. Cows did not initiate aggression towards other cows in focal or scan observations, whether translocated or residential. We observed two behaviors (sexual, passive avoidance), which were not directed at or from translocated individuals. Translocated females engaged in either grazing, standing or lying down. Our observations suggest the residents have accepted the translocated females in the herds observed.

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**RIETVELD QUANTITATIVE X-RAY DIFFRACTION ANALYSIS OF HEAVY MINERALS**

Matthew R. Winburn, Naomi R. Winburn, Ryan S. Winburn

*(1) Chemistry, Minot State University, Minot, ND (2) Rare Earth Salts Inc., Beatrice, NE*

Currently, research on heavy minerals at Minot State University uses optical microscopy to quantify samples. Optical microscopy can be time consuming and is unable to quantify opaque minerals. Rietveld quantitative X-ray diffraction (RQXRD) could be a tool to be used either in conjunction with, or as a direct substitute for, optical microscopy. The goal of this project is to quantify heavy mineral phase composition using RQXRD, compare results to optical microscopy, and to characterize solid solution phases to the furthest extent possible. To determine if RQXRD would be a viable tool for this type of analysis, a series of optimal parameters would need to be established. Mounting technique, internal standard, refinement of solid solution phases, and segregation of samples are the areas to be investigated to optimize the accuracy of the RQXRD method. Once the accuracy of the RQXRD method has been determined to be sufficient, the results will be compared to those obtained previously through optical microscopy. This will allow the viability of the RQXRD method in the analysis of heavy mineral assemblages to be determined. Based on previous research, it is expected that RQXRD will be found to be a suitable means of quantifying heavy mineral abundances, either in conjunction with optical microscopy or as an independent means of analyzing samples.

Support: Minot State University and Rare Earth Salts

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Winburn  
Undergraduate  
Poster

## METHOD OPTIMIZATION FOR CATECHOLAMINE SOLVENTS AND EXTRACTION FROM CULTURED ADRENAL CELL MEDIA

Matthew R. Winburn, Eric Olson, Naomi R. Winburn, Bryan Schmidt

*(1) Chemistry, Minot State University, Minot, ND*

The solubility of catecholamines (CAT) and their extraction from cultured adrenal cell media were investigated. Because the product would be measured with gas chromatography mass spectrometry, a non-aqueous extraction solvent was required. The extracting solvent must also be immiscible with water to allow partitioning and separation of the extracting solvent. Previous preliminary results suggested that octanol with a ammonium tetraphenylborate (TPB) salt was viable extracting solvent. However, neither TPB nor any CAT was soluble in spectral grade octanol. Epinephrine (Epi) and TPB were used for further solvent testing to find a suitable extracting solvent. Epi is known to be soluble in methanol, but its miscibility with water makes it an unsuitable extracting solvent. Other organic solvents with polarities as close to methanol that are immiscible with water were tested. TPB was first added to each solution first, but it was discovered that it is less soluble than Epi and has conflicting solubility with Epi. Benzyl alcohol without TPB appears to have the highest Epi solubility, but the solution changes color to a light pink/orange upon addition of the epinephrine, suggesting a degradation product is being formed. The results show that benzyl alcohol is the most promising solvent for CAT and their extraction from cell culture media, but further research is needed to determine if there is a chemical reaction between benzyl alcohol and Epi that is degrading either one.

Support: Minot State University and INBRE

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# CONSTITUTION OF THE NORTH DAKOTA ACADEMY OF SCIENCE

*Founded 1908, Official State Academy 1958*

## ARTICLE I. *Name and Purpose*

### Section 1.

This association shall be called the NORTH DAKOTA ACADEMY OF SCIENCE.

### Section 2.

The purpose of this association shall be to promote and conduct scientific research and to diffuse scientific knowledge.

## ARTICLE II. *Membership*

Membership in the Academy shall be composed of persons who share the stated purpose of the Academy and who are active or interested in some field of scientific endeavor.

## ARTICLE III. *Council*

The officers of the Academy shall be a President, a President-Elect, and a Secretary-Treasurer. The Council, consisting of the officers, the retiring President, and three elected Councilors, shall be responsible for the fulfillment of the scientific and business obligations of the Academy.

## ARTICLE V. *Dissolution and Limits of Action*

### Section 1.

In the event of dissolution of the Academy, any remaining assets shall be distributed to organizations organized and operated exclusively for education and scientific purposes as shall at the time qualify as exempt organizations under Section 501(c) (3) of the Internal Revenue Code of 1954.

### Section 2.

No substantial part of the activities of the Academy shall be the carrying on of propaganda, or otherwise attempting to influence legislation, and the Academy shall not participate in or intervene in, any political campaign on behalf of any candidate for public office.

### Section 3.

No part of any net earnings shall inure to the benefit of, or be distributable to, Academy members or officers, or other private persons, except that the Academy may authorize the payment of reasonable compensation for services rendered.

## ARTICLE VI. *Amendments*

### Section 1.

This Constitution may be amended at any annual Business Meeting of the Academy by a two-thirds vote. Proposed amendments shall be submitted in writing to the Secretary-Treasurer who shall send them to the members at least two weeks before the meeting at which such amendments are to be considered.

### Section 2.

Bylaws may be adopted or repealed at any regular business meeting by a two-thirds vote.



# **BYLAWS OF THE NORTH DAKOTA ACADEMY OF SCIENCE**

## **BYLAW 1. *Meetings***

### **Section 1. *Scientific Meetings.***

The Academy shall hold at least one annual scientific meeting each year at a time and place determined by the Council. Other scientific meetings, regional, state, or local, may be held at times and places determined by the Council. The Council shall establish regulations governing the presentation of papers at Academy sessions. Such regulations shall be made available to members at least three months before any meeting at which they are to apply.

### **Section 2. *Business Meetings.***

A Business Meeting of the membership shall be scheduled at the regular, annual scientific meeting of the Academy. Ten percent of the active members shall constitute a quorum at the annual business meeting.

### **Section 3. *Special Meetings.***

Special meetings shall be called by the President upon the request of ten percent of the active members and require twenty percent of the active members for a quorum. Notice of the time and place of such meetings shall be sent to all members of the Academy at least four weeks in advance of the meeting. Only matters specified in the call can be transacted at a special meeting.

### **Section 4. *Procedure.***

Parliamentary procedures to be followed in all business meetings shall be those specified in "Standard Code of Parliamentary Procedure" by Alice F. Sturgis.

## **BYLAW 2. *Financial***

### **Section 1. *Fiscal year.***

The fiscal year shall run concurrently with the calendar year from January 1 to December 31.

### **Section 2. *Dues and Assessments.***

The annual dues and assessments may be changed from time to time by the Council, subject to approval by a two-thirds vote of the members at an annual Business Meeting. These dues are payable by January 31 for the current fiscal year or by the Annual North Dakota Academy of Science Meeting for those registering for the meeting.

### Section 3. *Supporting Members.*

Council shall maintain a program to encourage members to voluntarily contribute funds over and above the regular dues and assessments for the support of activities of the Society.

### Section 4. *Sustaining Members.*

Any association, corporation, institution, or individual desiring to support the Society with funds or services valued at \$50 or greater may be invited by the President or designee to become a Sustaining Associate.

### Section 5. *Audit and Reports.*

The Nominating Committee shall appoint on a yearly basis one member who is not a member of Council to conduct at least one internal audit per year. The Secretary-Treasurer shall report on the financial affairs of the Society, including the results of an annual audit, as may be requested by the Council.

## BYLAW 3. *Membership*

### Section 1. *Membership Categories.*

Classes of membership shall include the following: (a) Regular, (b) Student, (c) Emeritus, (d) Honorary, (e) Supporting, (f) Sustaining, and (g) Lifetime Members.

### Section 2. *Eligibility and Procedure for Membership.*

Candidates for membership, except Sustaining Member, may be proposed by any regular or emeritus member of the Academy by submitting the candidate's name to the chairman of the Membership Committee.

#### (a) *Regular Members.*

Any person who is active or interested in some field of scientific endeavor shall be eligible for regular membership. A majority vote of Council shall elect to regular membership.

#### (b) *Student Members.*

Any student who is an undergraduate or graduate student in some field of science shall be eligible for student membership. A majority vote of Council shall elect to regular membership.

(c) *Emeritus Members.*

Any member in good standing upon formal retirement is eligible for emeritus membership. A majority vote of Council shall elect to emeritus membership.

(d) *Honorary Members.*

The Academy may recognize, by awarding honorary membership, any person (non-member or member) who has in any way made an outstanding contribution to science. It shall be the responsibility of the Membership Committee to be aware of individuals whom it would be fitting for the Academy to honor in this fashion. A two-thirds vote of members attending the annual business meeting shall elect to honorary membership.

(e) *Supporting Members.*

Regular or student members may voluntarily contribute funds over and above the regular dues and assessments for the support of activities of the Society.

(f) *Sustaining Associates.*

Any association, corporation, institution, or individual desiring to support the Society with funds or services valued at \$50 or greater may be invited by the President or designee to become a Sustaining Associate.

(g) *Lifetime Members.*

Any regular member in current good standing for at least one year may become a Lifetime Member by paying an assessment equal to 18 times the current annual dues in one lump sum or in two equal payments over the current and following year.

Section 3. *Privileges of Membership.*

- (a) Voting at the annual business meeting is permitted of regular and emeritus members.
- (b) Members of all categories may attend business meetings of the Academy.
- (c) The Secretary-Treasurer and members of Council must be regular members in good standing.
- (d) Regular, student, and emeritus members may submit abstracts or communications for scientific meetings of the Academy.

- (e) Emeritus and Honorary Members shall be exempt from payment of dues.
- (f) A Sustaining Member is provided a display area at the annual scientific meeting of five linear feet per \$50 donation up to a maximum of 20 linear feet.
- (g) Every member in good standing shall receive a printed copy or an electronic copy (if available and of equal or lesser cost than the printed copy) of the annual *Proceedings of the North Dakota Academy of Science*, the form to be determined by the member.
- (h) Special offices such as Historian may be created by the unanimous vote of the regular members at the annual Business Meeting.
- (i) All student research participants shall receive a properly inscribed certificate.

#### Section 4. *Forfeiture of Membership.*

##### (a) *Nonpayment of dues.*

Members shall be dropped from the active list on 31 November following the non-payment of dues during the membership year commencing the previous 1 December. A member may return to the active list by paying the current year dues.

##### (b) *Expulsion for cause.*

Membership may be terminated for conduct injurious to the Academy or contrary to the best interests of the Academy. The accused member shall be given an opportunity for a hearing before the Council. If a majority of the Council votes to expel the member, the action must be ratified by at least two-thirds of the members present at the next annual business meeting of the Academy. An expelled member shall forfeit all paid dues and assessments.

#### BYLAW 4. *Duties and Responsibilities of the Council and Council Members*

##### Section 1. *Council.*

The Council shall meet, at the call of the President, at least twice a year. The Council shall:

- (a) be the governing board of the Academy, responsible only to the membership.
- (b) arrange for programs, approve committee appointments, be responsible for the fiscal affairs of the Academy, and transact such business as necessary and desirable for function and growth of the Academy.

- (c) determine the location of the Annual Meeting three years in advance.
- (d) annually appoint an Academy representative to the National Association of Academies of Science and to Section X (General) of the American Association for the Advancement of Science.
- (e) shall appoint and may compensate a Secretary-Treasurer.
- (f) shall appoint and may compensate an Editor of the *Proceedings* and other publications.
- (g) shall be empowered to charge a publication fee of authors on a per page basis.
- (h) shall control all activities of the Academy including grant applications.

#### Section 2. *President.*

The President shall preside at meetings of the Council and over the annual business meeting of the Academy at the close of the regular term office. The President shall vote only to break a tie. Unless otherwise specified, the President shall, with the approval of the Council, appoint members to serve on Standing Committees and *ad hoc* Committees, designate the chair of each Committee, and appoint representatives to other organizations. The President serves as Coordinator of the Local Arrangements Committee for the Annual Meeting that occurs at the end of the President's term.

#### Section 3. *President-Elect.*

The President-elect shall be considered a vice president and shall serve as such in the absence of the President.

#### Section 4. *Past-President.*

The retiring President shall serve as Past-President and chair of the Nominating Committee. The Past-President shall serve *ex officio* on those committees designated by the President and shall serve in the absence of the President and President-Elect.

#### Section 5. *Secretary-Treasurer.*

The Secretary-Treasurer shall:

- (a) Assist Council in carrying on the functions of the Academy including the receipt and disbursement of funds under the direction of Council.
- (b) Manage the Academy Offices under Council's general supervision.
- (c) Serve as Managing Editor of the *Proceedings of the North Dakota Academy of Science*.

- (d) Prepare a summary of the most recent audit and a report of the Academy's current financial status. This information shall be shared with the membership at the annual business meeting and published in the *Proceedings* following the business meeting.
- (e) Perform all other duties of the Secretary-Treasurer listed in the Bylaws.
- (f) Serve as archivist and be responsible for all official records, archives, and historic material which shall be in reposit with the Secretary-Treasurer.

#### BYLAW 5. *Appointment, Nomination and Election of Members of Council*

##### Section 1. *Eligibility for Office.*

All candidates for election or appointment to the Council must be regular members in good standing. Nominees for President-Elect must be members who reside within easy commuting distance of the site of the Annual Meeting selected by the Council that occurs when the President-Elect serves as President.

##### Section 2. *Nomination Procedures.*

The Nominating Committee shall be responsible for all nominations to elective office, shall determine the eligibility of nominees, shall ascertain that nominees are willing to stand for office, and shall be required to advance to the Secretary-Treasurer at least two names for each open position as needed. Academy members shall have been encouraged to suggest nominees to the committee prior to the Committee submitting its report.

##### Section 3. *Election Procedures.*

Election shall be by secret mail ballot. The Secretary-Treasurer shall prepare a printed ballot that bears all names submitted by the Nominating Committee, that contains a brief biography of each candidate, and that has space for write-in candidates for each office. This ballot is to be mailed to all members no later than 1 November. Each member wishing to vote must return the marked ballot in a sealed signed envelope to the Secretary-Treasurer postmarked not more than thirty days after the ballots were mailed out to members. The President shall appoint tellers, who shall count the ballots that have been received by the Secretary-Treasurer and the tellers shall present the results in writing to the President. A plurality of the votes cast shall be necessary to elect and in the case of a tie vote, the President shall cast the deciding vote. The results of the election shall be announced at the annual Business Meeting.

##### Section 4. *Term office.*

A President-Elect shall be elected annually by the membership and the following years shall succeed automatically to President and Past-President to constitute a three-year nonrenewable term. Three Councilors shall be elected by the membership to three-year, non-renewable terms on a rotating basis. All elected Council members shall take office

at the end of the next annual Business Meeting following election and shall continue until relieved by their successors. Council is empowered to appoint and compensate a Secretary-Treasurer to successive three-year terms that commence with the beginning of the fiscal year.

#### Section 5. *Removal from office or position.*

If for any reason any elected member of Council is unable to fulfill his/her duties, the Council member may be removed from office by two-thirds vote of Council. If for any reason the Secretary-Treasurer is unable to fulfill his/her duties, the Secretary-Treasurer may be relieved of all duties by a majority vote of Council.

#### Section 6. *Interim vacancies.*

Should a vacancy occur in the Presidency, the Council by a majority vote shall appoint a member of the Academy able to coordinate the next Annual Meeting to fill the unexpired term. A retiring interim President shall succeed automatically to Past-President. Should a vacancy occur in the Presidency-Elect, the Council shall reassess and change the location of the coinciding Annual Meeting as necessary and then call for a special election by mail ballot. An interim vacancy in the Past-Presidency shall be filled by the most recently retired Past-President able to fill the duties of the Past-President. Persons appointed to fill the unexpired term of Secretary-Treasurer are expected to remain in the position for a minimum of three years. A vacancy in the office of Councilor shall be filled by a majority vote of Council until the following election at which time the interim Councilor may stand for a full three year nonrenewable term.

### BYLAW 6. *Committees*

#### Section 1. *Standing Committees.*

Standing committees shall include but not be limited to, the following: Editorial, Education, Denison Award, Necrology, Nominating, Resolution, Membership, and Audit Committees. The President shall appoint members of committees other than the Nominating and Audit Committees.

#### Section 2. *Editorial Committee.*

The Editorial Committee shall consist of three regular members appointed to three-year terms. The duties are explained in BYLAW 7 (Publications).

#### Section 3. *Education Committee.*

The Education Committee shall consist of five regular members and two high school teachers appointed to five-year terms. The Education Committee shall work with high school students and teachers in the state, in visitation programs, Science Talent Search programs, and other programs to stimulate an interest in science by the youth of the state. It shall operate the Junior Academy of Science program and administer the AAAS

high school research program.

Section 4. *Denison Awards Committee.*

The Denison Awards Committee shall consist of six regular members appointed to three-year terms. The Denison Awards Committee shall have as its prime duty the judging of student research and paper competitions, both undergraduate and graduate, and any other similar competitions. The committee shall also maintain the criteria to be used in the judging and selection of papers, such criteria to be circulated to prospective competitors.

Section 5. *Necrology Committee.*

The Necrology Committee shall consist of three regular members appointed to three-year terms. The Necrology Committee shall report to the Annual Meeting on those deceased during the preceding year. Obituaries may be included in the minutes of the Annual Meeting and/or published in the *Proceedings*.

Section 6. *Nominating Committee.*

The Nominating Committee shall consist of the five most recent past-presidents. The major duties of the Nominating Committee are listed in BYLAW 5 (*Appointment, Nomination and Election of Members of Council*). The Nominating Committee will also administer the selection process, develop a separate funding source for a monetary award, and develop, for Executive Committee approval, the criteria for the North Dakota Academy of Science Achievement Award.

Section 7. *Resolution Committee.*

The Resolution Committee shall consist of three regular members appointed to three-year terms. The Resolution Committee shall prepare such resolutions of recognition and thanks as appropriate for the Annual Meeting. Further, the Committee shall receive suggested resolutions for the membership and transmit such resolutions and the Committee recommendation to the membership.

Section 8. *Membership Committee.*

The Membership Committee shall consist of unlimited numbers of regular members appointed annually.

Section 9. *Audit Committee.*

The Nominating Committee shall appoint on a yearly basis one member who is not a member of Council to conduct at least one internal audit per year.

Section 10. *State Science Advisory Committee.*



The State Science Advisory Committee (SSAC) shall consist of five regular or emeritus members appointed to four-year terms. The SSAC shall serve to direct questions of a scientific nature to the appropriate expert as requested, shall inform regional granting agencies and state and national science policymakers of its expertise and availability and shall counsel those agencies and persons upon their request. The SSAC shall adhere in particular to the guidelines described in Article V, Section 2 of the Constitution.

#### Section 11. *Ad hoc Committees.*

The President may appoint such additional committees as may be needed to carry out the functions of the Academy. *Ad hoc* committees serve only during the tenure of the president who appointed them. Reports of *ad hoc* committees shall be presented to Council or to the Annual Meeting.

### BYLAW 7. *Publications*

#### Section 1. *Editorial Committee.*

Three regular members are appointed to the Editorial Committee for renewable three-year terms. The Editorial Committee shall develop and recommend the Academy publication program and policies to the Council. It will assist the Editors of each official publication in reviewing manuscripts for those publications that include the *Proceedings*. Chairs of symposia will review manuscripts written for relevant symposia.

#### Section 2. *Managing Editor.*

The Secretary-Treasurer shall serve as the managing editor.

#### Section 3. *Editor.*

Editors shall serve three-year terms. The Editors shall edit all official publications of the Academy, including the *Proceedings*.

### BYLAW 8. *Memorial Fund*

The Council of the Academy shall establish a J. Donald Henderson Memorial Fund and administer this fund so that the proceeds will be used to promote science in North Dakota.

### BYLAW 9. *Fiscal Year*

The fiscal year of the North Dakota Academy of Science, for the purpose of financial business, shall be 1 January to 31 December.

### BYLAW 10. *Achievement Award*

The Academy establishes the North Dakota Academy of Science Achievement Award to be

given periodically to an Academy member in recognition of excellence in one or more of the following:

- (a) Nationally recognized scientific research.
- (b) Science education.
- (c) Service to the Academy in advancing its goals.

The Nominating Committee will administer the selection process, will develop a separate funding source for a monetary award, and will develop, for Council approval, the criteria for the award.

#### BYLAW 11. *Research Foundation*

The North Dakota Science Research Foundation is established as an operating arm of the Academy. The purposes of the Foundation are:

- (a) to receive funds from grants, gifts, bequests, and contributions from organizations and individuals, and
- (b) to use the income solely for the making of grants in support of scientific research in the State of North Dakota.

Not less than 50% of the eligible monies received shall be placed in an endowment from which only the accrued interest shall be granted.

The Foundation shall be responsible for soliciting the funds for the purposes described. The Foundation funds shall be in the custody of the Secretary-Treasurer of the Academy and shall be separately accounted for annually. The Foundation Board of Directors shall be comprised of five members of the Academy, representing different disciplines. Members shall be appointed by the President of staggered five-year terms. The chairperson of the Board shall be appointed annually by the President. The Board shall be responsible for developing operating procedures, guidelines for proposals, evaluation criteria, granting policies, monitoring procedures, and reporting requirements, all of which shall be submitted to the Executive Committee for ratification before implementation.

The Foundation shall present a written and oral report to the membership of the Academy at each Annual Meeting, and the Secretary-Treasurer shall present an accompanying financial report.

#### BYLAW 12. *Affiliations*

The Academy may affiliate itself with other organizations that have purposes consistent with the purposes of the Academy. Such affiliations must be approved by the Council and by a majority of those attending a regularly scheduled business meeting of the membership.

#### BYLAW 13. *Indemnification*

## Section 1.

Every member of the Council or employee of the North Dakota Academy of Science shall be indemnified by the Academy against all expenses and liabilities, including counsel fees, reasonably incurred or imposed upon him/her in connection with any proceedings to which he or she may be made part, or in which he or she may become involved, by reason of being or having been a member of the Council, or employee at the time such expenses are incurred, except in such cases wherein the member of the Council or employee is adjudged guilty of willful misfeasance or malfeasance in the performance of his or her duties. Provided, however, that in the event of a settlement of the indemnification herein shall apply only when the Council approves such settlement and reimbursement as being for the best interests of the Academy. The foregoing right of indemnification shall be in addition to and not exclusive of all other rights to which such members of the Council or employee may be entitled.

## ACADEMY OFFICERS AND COMMITTEES

### Executive Committee Membership

President	Secretary (three-year term)
Past-President	Treasurer (three-year term)
President-Elect	Councilors (three-year term)

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## COMMITTEES OF THE NORTH DAKOTA ACADEMY OF SCIENCE

Executive Committee	Diane Darland, University of North Dakota Zeni Shabani, Minot State University  Stuart J. Haring, North Dakota State University Bryan Schmidt, Minot State University Christopher Keller, Minot State University
Editorial Committee	Joshua Steffan, Dickinson State University
Education Committee	Douglas Munski, University of North Dakota Yun Ji, University of North Dakota Sergei Nechaev, University of North Dakota
Denison Awards Committee	Van Doze, University of North Dakota Diane Darland, University of North Dakota Yarong Yang, North Dakota State University
Necrology Committee	
Nominating Committee	
State Science Advisory Committee	Frank Xiao, University of North Dakota Mafany Mongoh, Sitting Bull College
Resolutions Committee	Kaylee Dockter, Minot State University Joel Collins, Minot State University Paul Lepp, Minot State University
Membership Committee	
Audit Committee	
North Dakota Research Foundation Board of Directors	Birgit Pruess, North Dakota State University Jerzy Bilski, Valley City State University Paul Lepp, Minot State University
Historian	Alexey Shipunov

**PAST PRESIDENTS AND LOCATIONS  
OF ANNUAL MEETINGS OF THE NORTH DAKOTA ACADEMY OF SCIENCE**

<u>Year</u>	<u>President</u>	<u>Location</u>	<u>Year</u>	<u>President</u>	<u>Location</u>
1909	M. A. Bannon	Grand Forks	1946	J. A. Longwell	Fargo
1910	M. A. Bannon	Fargo	1947	A. M. Cooley	Grand Forks
1911	C. B. Waldron	Grand Forks	1948	R. H. Harris	Fargo
1912	L. B. McMullen	Fargo	1949	R. B. Winner	Grand Forks
1913	Louis VanEs	Grand Forks	1950	R. E. Dunbar	Fargo
1914	A. G. Leonard	Fargo	1951	A. K. Saiki	Grand Forks
1915	W. B. Bell	Grand Forks	1952	Glenn Smith	Fargo
1916	Lura Perrine	Fargo	1953	Wilson Laird	Grand Forks
1917	A. H. Taylor	Grand Forks	1954	C. O. Glagett	Fargo
1918	R. C. Doneghue	Fargo	1955	G. A. Abbot	Grand Forks
1919	H. E. French	Grand Forks	1956	H. B. Hart	Jamestown
1920	J. W. Ince	Fargo	1957	W. E. Comatzer	Grand Forks
1921	L. R. Waldron	Grand Forks	1958	W. C. Whitman	Fargo
1922	Daniel Freeman	Fargo	1959	Arthur W. Koth	Minot
1923	Norma Preifer	Grand Forks	1960	H. J. Klosterman	Fargo
1924	O. A. Stevens	Fargo	1961	Vera Facey	Grand Forks
1925	David R. Jenkins	Grand Forks	1962	J. F. Cassel	Fargo
1926	E. S. Reynolds	Fargo	1963	C. A. Wardner	Grand Forks
1927	Karl H. Fussler	Grand Forks	1964	Fred H. Sands	Fargo
1928	H. L. Walster	Fargo	1965	P. B. Kannotski	Grand Forks
1929	G. A. Talbert	Grand Forks	1966	Paul C. Sandal	Fargo
1930	R. M. Dolve	Fargo	1967	F. D. Holland, Jr.	Grand Forks
1931	H. E. Simpson	Grand Forks	1968	W. E. Dinusson	Fargo
1932	A. D. Weedon	Fargo	1969	Paul D. Leiby	Minot
1933	G. C. Wheeler	Grand Forks	1970	Roland G. Severson	Grand Forks
1934	C. I. Nelson	Fargo	1971	Robert L. Burgess	Fargo
1935	E. A. Baird	Grand Forks	1972	John C. Thompson	Dickinson
1936	L. R. Waldron	Fargo	1973	John R. Reid	Grand Forks
1937	J. L. Hundley	Grand Forks	1974	Richard L. Kiesling	Fargo
1938	P. J. Olson	Fargo	1975	Arthur W. DaFoe	Valley City
1939	E. D. Coon	Grand Forks	1976	Donald R. Scoby	Fargo
1940	J. R. Dice	Fargo	1977	Om P. Madhok	Minot
1941	F. C. Foley	Grand Forks	1978	James A. Stewart	Grand Forks
1942	F. W. Christensen	Fargo	1979	Jerome M. Knoblich	Aberdeen, SD
1943	Neal Weber	Grand Forks	1980	Duane O. Erickson	Fargo
1944	E. A. Helgeson	Fargo	1981	Robert G. Todd	Dickinson
1945	W. H. Moran	Grand Forks	1982	Eric N. Clausen	Bismarck

<b><u>Year</u></b>	<b><u>President</u></b>	<b><u>Location</u></b>
1983	Virgil I. Stenberg	Grand Forks
1984	Gary Clambey	Fargo
1985	Michael Thompson	Minot
1986	Elliot Shubert	Grand Forks
1987	William Barker	Fargo
1988	Bonnie Heidel	Bismarck
1989	Forrest Nielsen	Grand Forks
1990	David Davis	Fargo
1991	Clark Markell	Minot
1992	John Brauner	Grand Forks
1993	John Brauner	Jamestown
1994	Glen Statler	Fargo
1995	Carolyn Godfread	Bismarck
1996	Eileen Starr	Valley City
1997	Curtiss Hunt	Grand Forks
1998	Allen Kihm	Minot
1999	Joseph Hartman	Grand Forks
2000	Mark Sheridan	Moorhead, MN
2001	Ron Jyring	Bismarck
2002	Jody Rada	Grand Forks
2003	Richard Barkosky	Minot
2004	Anna Grazul-Bilska	Fargo
2005	Holly Brown-Borg	Grand Forks
2006	Andre Delorme	Valley City
2007	Chris Keller	Minot
2008	Van Doze	Grand Forks
2009	Birgit M. Pruess	Fargo
2010	Paul W. Lepp	Minot
2011	Lyle Best	Belcourt
2012	Michael A. Bingle-Davis	Bismarck
2013	Keith Henry	Grand Forks
2014	Jerzy Bilski	Valley City
2015	Stuart J. Haring	Fargo
2016	Stuart J. Haring	Fargo
2017	Julia Xiaojun Zhao	Grand Forks
2018	Zeni Shabani	Minot
2019	Diane Darland	Grand Forks

# MINUTES OF THE NORTH DAKOTA ACADEMY OF SCIENCE

## ANNUAL BUSINESS MEETING 2018

The meeting was called to order by President Shabani at 4:41 pm, Friday, April 27, 2018.

Discussion of Academy finances began with a submission by Secretary Haring of the costs of the 2018 NDAS Meeting:

Wireless Laser Presenters/Pointers	\$161.22
Form Publisher	\$42.00
NDSU Printing	\$414.15
Honorarium - Speaker	\$1,000.00
Travel - Speaker	\$452.00
Accommodations - Speaker	\$210.96
Meals - Speaker	\$29.03
MSU Catering	\$3,868.28
MSU Development Foundation Awards (Undergraduate)	\$1,200
MSU Development Foundation Awards (Graduate)	\$800
Denison Awards (Undergraduate)	\$450
Denison Awards (Graduate)	\$450
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Total	\$9,077.64

These costs were underwritten in part by the MSU Development Foundation's contribution of \$2,000 and collected registration fees of \$5,603.07 (total = \$7,603.07). There was also a promise of \$500 from the North Dakota University System Foundation by Chancellor Mark Hagerott.

As of April 26, 2018, the following were accounts and balances held by the Academy:

PayPal	(includes registration fees)	\$7,848.04
USBank - Checking	(includes \$2,000 deposit from MSU)	\$10,171.09
USBank - Savings		\$156,066.94
USBank - Savings		\$4,546.63
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Total		\$178,632.70

Discussion of the finances of the Academy focused on what to do with the large amount currently held in savings. Most of these funds (approximately \$145,000) resulted from the recent repossession and sale of stocks held since sometime in the 1980s by the Academy (see the minutes of the 2017 and 2016 meetings for more). Doug Munski moved (seconded by Bryan Schmidt) that the President appoint 3-5 members (from at least 3 different institutions) to investigate how best to invest the money and to then secure a vote of the society by email, so that funds might then be so invested. Motion carried. President Shabani then appointed Julia Xiaojun Zhao (UND), Lyle Best (TMCC), Stuart Haring (NDSU), Ron Jyring (BSC) and Paul Lepp (MiSU) to the committee. Paul Lepp was appointed convener.

Discussion of when to hold next year's meeting centered on the problem of conflicting meetings in late spring and the problem of winter weather impacting earlier meetings. Stuart



Haring moved (seconded by Doug Munski) that a one-day meeting be held at UND on either Friday, March 1 or Friday March 8, 2019, to be determined by President-Elect Diane Darland. If neither date were available, then Friday, April 12, 2019 was suggested as the next possibility. Motion carried.

Dr. Joseph Collette (MiSU) was elected President-Elect by acclamation. The consensus (no motion) at the meeting was that Dr. Collette should host the 2019-2020 meeting in the fall (preferably on the Monday of Thanksgiving week) in Fargo (at NDSU). Stuart Haring pledged his assistance with on-site organizing.

At the 2018 Annual Meeting, in addition to 25 faculty/postdoctoral/graduate/undergraduate posters, there were 3 faculty/professional talks, 17 graduate student talks, and 16 undergraduate student talks. Due to the generosity of the MSU Development Foundation, this year additional awards were presented. The award winners were:

#### Undergraduate - MSU Development Foundation

1st	\$600	Sydney Houlton	Minot State University
2nd	\$400	Erin Richards	North Dakota State University
3rd	\$200	Brody Burnett	Minot State University

#### Graduate - MSU Development Foundation

1st	\$500	Jiyan Mohammed	North Dakota State University
2nd	\$300	Bethany Davis	University of North Dakota

#### Undergraduate - A. Rodger Denison Competition

1st	\$200	Chandler Jacob	Minot State University
2nd	\$150	Paige Clark	Minot State University
3rd	\$100	Kalsi Heimdal	Minot State University

#### Graduate - A. Rodger Denison Competition

1st	\$200	Trevor Baumgartner	North Dakota State University
2nd	\$150	Kwaku Baryeh	North Dakota State University
3rd	\$100	Nii Koney-Kwaku Koney	University of North Dakota

The meeting adjourned at 5:32 PM.

Respectfully submitted,  
Christopher Keller (MiSU)

## LIFETIME MEMBERS

F. D. "Bud" Holland  
Ron Jyring  
Allen Kihm  
Bonnie Heidel