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Volume 74 December 2020

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

2019-2020

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112th Annual Meeting

December 4, 2020

Virtual Conference through the North Dakota Academy of Science Blackboard Organization

TABLE OF CONTENTS

EDITOR'S NOTES

Welcome to the *Proceedings of the North Dakota Academy of Sciences* for the 112th Annual Meeting of the Academy. This has been an interesting year to say the least. Due to the SARS-CoV-2 pandemic, the annual meeting scheduled for the spring had to be moved back to December, and of course, until a vaccine is ultimately approved, administered, and ultimately the immunity of the population as a whole is fortified, it is in everyone's best interest that social distancing practices be implemented and followed to minimize spread. In response to this, the 2020 annual meeting is being held virtually (for the first time ever) utilizing video conferencing resources kindly provided by the North Dakota University System.

As has been provided every year concurrently with the annual meeting, a slightly abbreviated *Proceedings* has been put together. 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 and have provided students with opportunities and guidance 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. Special thanks goes out to the President, Dr. Joe Collette, as he has worked diligently to even make this virtual meeting possible. This tireless effort included the challenge of setting up a Blackboard Organization page as the online container for disseminating this meeting virtually. This will undoubtedly be useful not only on this occasion, but also for years to come as the Academy adapts to incorporating future technologies into information dissemination.

As always, 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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The listserv will be maintained and updated throughout the year. In addition to receiving periodic email from NDAS, one may also send email to all subscribers of the listserv. All communications will be monitored and approved by a moderator for the listserv to avoid the forwarding of any spam or unsolicited emails.

SCHEDULE

The entire meeting will be held virtually through the NDAS Blackboard Organization site.

For access to all morning sessions (8:40 AM-NOON), click here.
For access to all afternoon talks (1:00-4:00 PM), click here.

Start Time	End Time	Presenter
8:40 AM	9:00 AM	**WELCOME AND OPENING REMARKS** *NDAS President Collette*
9:00 AM	9:15 AM	Sun (G)
9:20 AM	9:35 AM	Carter (U)
9:40 AM	9:55 AM	Achatz (G)
10:00 AM	10:15 AM	Wu (G)
10:20 AM	10:35 AM	Reagen (G)
10:40 AM	10:55 AM	He (G)
11:00 AM	11:15 AM	Martens (G)
11:20 AM	11:35 AM	Onwumelu (G)
11:40 AM	11:55 AM	Hoque (G)
NOON	12:55 PM	*LUNCH*
1:00 PM	1:15 PM	-----
1:20 PM	1:35 PM	LaVallie (G)
1:40 PM	1:55 PM	Bergelin (G)
2:00 PM	2:15 PM	Haring (F)
2:20 PM	2:35 PM	Bertch (U)
2:40 PM	2:55 PM	Pruess (F)
3:00 PM	3:15 PM	Ahlbrecht (U)
3:20 PM	3:35 PM	-----
3:40 PM	3:55 PM	-----
4:00 PM	5:30 PM	**POSTER SESSION**
5:00 PM	5:30 PM	**COMPETITION JUDGING** in *All faculty members are encouraged to participate.*
6:00 PM	7:15 PM	**KEYNOTE ADDRESS** *Dr. Sean Gulick* *University of Texas* *"Life and Death by Impact: Drilling for Clues"*
7:15 PM	7:30 PM	**AWARDS AND CLOSING REMARKS**
7:30 PM	8:00 PM	**BUSINESS MEETING** *All Academy members are encouraged to attend.*

U = undergraduate student; G = graduate student; F = faculty; PD = postdoc; PR = professional

TALKS

Clicking on the name of each presenter will take you to their abstract.
Clicking on the title will take you to the video session where the talk is being presented.

Time	Presenter	Title
9:00 AM	Sun (G)	ONE-POT SYNTHESIS OF RU/RGO NANOCATALYST FOR ELECTROCHEMICAL SYNTHESIS OF AMMONIA
9:20 AM	Carter (U)	RAPID SYNTHESIS OF N-[1-(4-CHLOROPHENYL)ETHYL]-N-METHYLFORMAMIDE
9:40 AM	Achatz (G)	WALKING WITH DINOSAURS: PHYLOGEOGRAPHY OF PROTERODIPLOSTOMIDS PARASITIC IN CROCODILIANS
10:00 AM	Wu (G)	PEI-COATED Fe3+ QUANTUM DOTS FOR ULTRASENSITIVE DETECTION OF H2O2 AND GLUCOSE
10:20 AM	Reagen (G)	SYNTHESIS OF FLUORESCENT GRAPHENE QUANTUM DOTS FOR IN VITRO CELL IMAGING AND METAL ION DETECTION
10:40 AM	He (G)	NEAR-INFRARED SEMICONDUCTING POLYMER DOTS FOR SENSING OF TEMPERATURE
11:00 AM	Martens (G)	AGENTS OF DARKNESS: UNDERSTANDING THE ETIOLOGICAL AGENTS OF BLACK SPOT DISEASE IN FISH
11:20 AM	Onwumelu (G)	EXPERIMENTAL INVESTIGATION OF MATURATION PROCESSES AND THEIR IMPACT ON ORGANIC MATTER
11:40 AM	Hoque (G)	GENETIC DIVERSITY ANALYSIS OF A CANOLA (BRASSICA NAPUS L.) GLOBAL COLLECTION
1:00 PM	-----	
1:20 PM	LaVallie (G)	ANALYSIS OF ORGANICS AND NONCONDENSABLE GASES PRESENT IN SUBCRITICAL WATER-TREATED ALKALI LIGNIN
1:40 PM	Bergelin (G)	AGE CONSTRAINT OF ANCIENT BURIED ICE MASS, ONG VALLEY, ANTARCTICA.
2:00 PM	Haring (F)	TEACHING GENETIC ENGINEERING USING MODERN GENE EDITING IN THE UNDERGRADUATE INSTRUCTIONAL LABORATORY
2:20 PM	Pruess (F)	TWO NOVEL ANTI-MICROBIALS ARE HEADING TOWARDS COMMERCIALIZATION NDAS PROCEEDINGS
2:40 PM	Ahlbrecht (U)	DERIVING A NORMALIZED VARIANT OF THE KSG TRANSFER ENTROPY
3:00 PM	Bertch (U)	TRANSFER ENTROPY PATHWAYS IN PROTEIN-DNA COMPLEXES
3:20 PM	-----	
3:40 PM	-----	

POSTERS

Clicking on the name of each presenter will take you to their abstract.
All posters have individual session links you can access by clicking on the title of the poster.

Presenter	Title
Elshanbary (U)	RAPID SYNTHESIS OF N-[1-(4-CYANOPHENYL)ETHYL]-N-METHYLFORMAMIDE
Fleck (U)	NEUROTRANSMITTER EFFECT ON E.COLI GROWTH AND EXPRESSION OF FLAGELLAR GENES
Garcia Michel (U)	DIRECTIONALITY IN PATHWAYS OF INFORMATION FLOW FOR ALLOSTERIC COMMUNICATION IN ERK2
Hanson (U)	CHEMISTRY OF INHALABLE PARTICLES FROM WELDING FUMES AT NUETA HIDATSA SAHNISH COLLEGE, NEW TOWN, ND
King (U)	EXPRESSION AND PURIFICATION OF A THERAPEUTICALLY RELEVANT MONOCLONAL ANTIBODY FROM CHO CELLS
Murphy (U)	EXPRESSION, PURIFICATION AND CHARACTERIZATION OF A NANOBODY WITH ANTI-MOUSE IgG SPECIFICITY
Scott (U)	RAPID SYNTHESIS OF N-[1-(4-METHOXYPHENYL)ETHYL]-N-METHYLFORMAMIDE
Simons (U)	RAPID SYNTHESIS OF N-METHYL-N,N-DI-(3-NITROBENZYL)AMINE
Vick (U)	RAPID SYNTHESIS OF N-METHYL-N-[1-(4-NITROPHENYL)ETHYL]FORMAMIDE
Winburn (U)	RAPID SYNTHESIS OF N-[1-(2,4-DICHLOROPHENYL)ETHYL]-N-METHYLFORMAMIDE
Archer (G)	EFFECT OF IN-ROW PLANT SPACING ON CANNABIS SATIVA L. ‘CHERRY WINE’ AND ‘SPECIAL SAUCE’
Bogenrief (G)	PRODUCTIVITY OF BOK CHOY (BRASSICA RAPA L. SSP. CHINENSIS) UNDER DIFFERENT IRRIGATION REGIMES
Han (G)	CYSTEINE DETERMINATION BASED ON FLUORESCENCE RESONANCE ENERGY TRANSFER OF AN ASSEMBLED NANOHYBRID
Kadium (G)	ANALYSIS OF DORMANCY ACCLIMATION RESPONSE IN INCOMPLETE DIALLEL POPULATION REPRESENTING NDSU-GGEP
Rana (G)	SEASON EXTENSION USING SUPPLEMENTAL HEAT IN A NORTH DAKOTA HIGH TUNNEL FOR SNAP BEAN AND BASIL
Sun (G)	FRET-BASED PVK@SiQDs NANOCOMPOSITE FOR ENHANCING QUANTUM YIELD AND STABILITY
Chevalier Plambeck (P)	CORE BIOLOGY FACILITY AND RESOURCES AT NDSU

KEYNOTE SPEAKER

Professor Sean Gulick, Ph.D.

Jackson School of Geosciences
University of Texas

Research Professor Sean Gulick, his students, and colleagues are working on tectonic and climate interactions in the St. Elias Mountains and Surveyor submarine fan, geohazards, and margin evolution of subduction and transform faulting in Alaska, Sumatra, and Japan, and the geologic processes and environmental effects of the Cretaceous-Paleogene Chicxulub meteor impact. To test some key hypotheses of how glacial erosion can perturb tectonics in 2013, Sean served as co-chief on the Integrated Ocean Drilling Program (IODP) Expedition 341: Southeast Alaska tectonics and climate. In 2014, Sean led the seismic imaging in a multidisciplinary cruise to the unexplored Sabrina Coast shelf in East Antarctica. In 2016, Sean served as co-chief scientist on the joint International Ocean Discovery and Continental Drilling Programs Expedition 364: Drilling the K-Pg Chicxulub impact crater.

Sean lives on a small ranch in Sunset Valley Texas with his wife, Dr. Jennifer Jobst, and their horses, dogs, cats, and chickens. He competes in medieval jousting tournaments and conducts medieval research as a hobby.

ABSTRACT - The most recent of Earth's five largest mass extinction events occurred 66 Mya, coeval with the impact of a ~12 km asteroid, striking at ~60 degrees into what is today the Yucatán Peninsula, México and producing the ~200 km-wide Chicxulub crater. This impact, by some estimations, drove the extinction of 75% of life on Earth at the genus level including all non-avian dinosaurs. Proposed kill mechanisms include thermal effects caused by the reentry of fast ejecta into Earth's atmosphere, dust and sulfate aerosols reducing Earth's solar insolation, ocean acidification, and metal toxicity due to the chemical make-up of the impactor. In 2016, 835 m of core was recovered from the Chicxulub impact structure through IODP-ICDP Expedition 364. Analyses done on these cores, downhole logs, and geophysical site survey data have led to a series of advancements to our understanding of impact cratering processes and to how the Chicxulub impact affected the Earth's environment leading to the Cretaceous-Paleogene mass extinction.

UNDERGRADUATE COMMUNICATIONS

IN THE

A. RODGER DENISON COMPETITION

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

Ahlbrecht
Undergraduate
Talk

DERIVING A NORMALIZED VARIANT OF THE KSG TRANSFER ENTROPY

Benjamin C. Ahlbrecht*, Daniel A. Barr

Chemistry, University of Mary, Bismarck, ND

Transfer entropy is a directed and non-parametric measure of uncertainty reduction that is useful for determining causal links between time series. Since continuous transfer entropy is theoretically unbounded from above and below, interpreting and comparing raw values may be ambiguous. To remedy this, we present a novel methodology for normalizing the continuous transfer entropy calculated using the Kraskov, Stögbauer, and Grassberger (KSG) estimator. This is done by determining theoretical maximum and minimum values given the dynamics of the system. We then adopt min-max normalization to ensure any given value lies within the desired bounds. Using vector autoregression models, we show the normalized transfer entropy provides an accurate, meaningful, and easily interpretable result.

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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Bertch
Undergraduate
Talk

TRANSFER ENTROPY PATHWAYS IN PROTEIN-DNA COMPLEXES

Autumn C. Bertch, Daniel A. Barr, Ph.D.

Chemistry, University of Mary, Bismarck, ND

Transfer entropy (TE) is a directional measure of uncertainty reduction one process has on another process. Transfer entropy was used to model the intramolecular interactions of the lac repressor protein-DNA headpiece bound to both its natural O1 operator and to non-specific DNA, as well as a mutant headpiece complex that mimics the specificity of the gal repressor. We calculate the pairwise transfer entropy across each protein-DNA complex to examine the relationships between individual residues by taking the sum of the transfer entropy each residue sends to all other residues in the protein. We selected the most driving and most receiving residues for further analysis. Doing so allowed us to construct transfer entropy pathways to provide an analysis of how residues physically influence each other and contribute to the dynamics of the protein. We found that hydrogen bonding, hydrophobic, or both, and sequence specific contact residues, in conjunction with certain DNA bases, play a large role in both the driving and receiving pathways. The information pathways eventually formed continuous information "loops". For each protein-DNA complex, the most driving residue pathways eventually flowed into a common information "loop", as did the most receiving residue pathways. This implies that the majority of information flow within a protein is found in these "loops".

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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Carter
Undergraduate
Talk

RAPID SYNTHESIS OF N-[1-(4-CHLOROPHENYL)ETHYL]-N-METHYLFORMAMIDE

Salina R. Carter, Lioudmila I. Bobyleva, MS, and Mikhail M. Bobylev, PhD

Salina Carter - Student, Lioudmila Bobyleva - research advisor, Mikhail Bobylev - research advisor

Rapid Synthesis of N-[1-(4-chlorophenyl)ethyl]-N-methylformamide
Salina R. Carter, Lioudmila I. Bobyleva, MS, and Mikhail M. Bobylev, PhD*
Division of Science – Chemistry, Minot State University, Minot, ND, 58707
* Author to whom the correspondence should be addressed [email: mikhail.bobylev@minotstateu.edu]

Background: Recently, we developed a rapid procedure for the Leuckart reaction and successfully applied it 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-(2,4-dichlorobenzyl)-N-methylamine, was produced with an isolated yield of 31.3%. N-(2,4-dichlorobenzyl)-N-methylformamide was produced as the main product with an isolated yield of 52.0%.
Hypothesis: Due to the presence of a methyl group attached to the carbonyl, the reaction on 4-chloroacetophenone will proceed slower and produce a higher yield of N-[1-(4-chlorophenyl)ethyl]-N-methylformamide and a lower yield of N,N-di[1-(4-chlorphenyl)ethyl]-N-methylamine.
Methods: The reaction was conducted on a 10 mmol scale at 185-187°C. Column chromatography was used for the isolation of the products of the reaction. NMR-spectroscopy and elemental analysis were used to determine the structures of the products.
Results: The reaction was complete in 40 minutes compared to 10 minutes for the reaction with 4-chlorobenzaldehyde. The isolated yield of N-[1-(4-chlorophenyl)ethyl]-N-methylformamide was 88.5%. N,N-di[1-(4-chlorphenyl)ethyl]-N-methylamine was not isolated or detected.
Conclusions: The results of the reaction support the initial hypothesis. The reaction provides a new method for the synthesis of N-[1-(4-chlorophenyl)ethyl]-N-methylformamide.
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.

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)

Achatz
Graduate
Talk

WALKING WITH DINOSAURS: PHYLOGEOGRAPHY OF PROTERODIPLOSTOMIDS PARASITIC IN CROCODILIANS

Tyler J. Achatz (1), Eric E. Pulis (2), Kerstin Junker (3), Jeffrey A. Bell (1), Francisco Tiago de Vasconcelos Melo (4), Vasyl V. Tkach (1)

(1) University of North Dakota, Grand Forks, North Dakota. (2) Northern State University, Aberdeen, South Dakota. (3) ARC-Onderstepoort Veterinary Institute, Onderstepoort, South Africa. (4) Institute of Biological Sciences, Federal University of Pará, Belém, PA, Brazil.

Crocodilians are an ancient group of reptiles that evolved at least 225 million years ago. The ancestors of today's crocodilians already inhabited the supercontinent Pangea prior to its breakup. The geographic range of crocodilians was fragmented and the descendants of early crocodilians were separated from each other by continental drift. Associated speciation and extinction events ultimately shaped today's fauna and distribution of crocodilians. The same likely happened to their parasites. Although parasites of crocodilians have not been studied sufficiently, it has been demonstrated that they possess a relatively rich and highly distinct helminth fauna. One of the most characteristic groups of helminths found in crocodilians is the digenean family Proterodiplostomidae. At least some proterodiplostomids have been found in every region of the planet inhabited by crocodilians. Prior molecular phylogenetic work on proterodiplostomids has been limited to only 2 species, neither of which were collected from crocodilians. The goal of our study was to infer phylogenetic relationships of proterodiplostomids of crocodilians and properly test the monophyly of most constituent genera using sequences of nuclear ribosomal DNA. The results based on specimens from 3 continents have provided evidence that at least some of today's proterodiplostomid lineages are very ancient and likely evolved before the break-up of supercontinents, thus reflecting long co-evolutionary history between these parasites and crocodilians. In addition, molecular phylogeny has permitted a reassessment of the taxonomic value of some morphological and biological characteristics of proterodiplostomids, resulting in amended systematics.

Support: Grants R15AI092622 (National Institutes of Health) and DEB1021431 (National Science Foundation) to VVT.
Joe K. Neel Memorial Award and W. H. Wheeler Award (University of North Dakota) and AMCOP Student Research Grant (Annual Midwestern Conference of Parasitologists) to TJA.

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Bergelin
Graduate
Talk

AGE CONSTRAINT OF ANCIENT BURIED ICE MASS, ONG VALLEY, ANTARCTICA.

Marie Bergelin, Jaakko Putkonen, Greg Balco, and Dan Morgan

University of North Dakota, Berkeley Geochronology Center, Vanderbilt University

We have collected a 10-meter ice core from a newly discovered massive buried ice mass in Ong Valley, Transantarctic Mountains, Antarctica. This ice mass is buried under a thin layer (< 1 m) of glacial debris and exposure dating from this overlying debris have revealed a minimum age of > 1.1 Ma, therefore making this one of the oldest ice bodies found on Earth. Such ancient ice mass can yield direct information about our past climate, past atmospheric chemistry, ancient life forms, and geology of greater antiquity than most currently known ice bodies.

Measured concentration of the cosmic-ray produced nuclides 10Be, 26Al, and 21Ne within trapped sediment down core are used to obtain constraints on the age, sublimation rate, and origin of this buried ice mass. These cosmogenic nuclides are produced by cosmic-ray interactions with minerals near the Earth's surface, and in this case suspended material embedded in the ice. As the production rate decreases rapidly with depth below the Earth's surface, the cosmogenic nuclide concentration yield information about the exposure history.

Measured cosmogenic nuclide concentrations provide a best-fit modeled age of 3.8 ± 0.5 Ma. However, coupled and validated with GPS measurements of lateral and end moraines, the age of this buried ice mass is more likely between 2 to 4 Ma. Further, unexpected large variation of cosmogenic nuclide concentrations downcore, suggests that the last few meters of the ice core may belong to a separate, older ice mass that has previously been exposed at the surface. Lateral moraines and measurements of cosmogenic nuclides in glacial debris further up valley suggest that this deeper, older ice may be > 2.6 Ma old, and was most likely buried during glacial advancement into Ong Valley less than 4 Ma ago.

Support: National Science Foundation

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He
Graduate
Talk

NEAR-INFRARED SEMICONDUCTING POLYMER DOTS FOR SENSING OF TEMPERATURE

Shuyi He*, Yingfen Wu, Xu Wu, Julia Xiaojun Zhao, Guodong Du

Chemistry, University of North Dakota, Grand forks, ND

Near-infrared (NIR) fluorescence imaging is an ideal cellular and tissue imaging because of the low absorption of biological molecules in this region and it can be performed in low background noise. Semiconducting polymer dots (Pdots) have received great attention due to their unique characteristics, including high water solubility, good light stability, excellent biocompatibility, and low cost. Herein, we report the nanoprecipitation route for the preparation of Pdots exhibiting NIR emission. Furthermore, the Pdots are proved as a very reliable temperature sensing probe (at 25–50°C). Impressively, the dual-readout approach featured with good accuracy and high sensitivity for temperature detection. Also, the Pdots possess outstanding optical properties and biocompatibility, making them a promising NIR imaging agent for in vivo targeting.

Support: This work was supported by NSF CHE 1709160, University of North Dakota Postdoctoral Pilot Program supported by UND VPR and Art and Science College, the North Dakota Industrial Commission Grant G-041-081, and Applied Research to Address the State's Critical Needs Initiative program.

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Hoque
Graduate
Talk

GENETIC DIVERSITY ANALYSIS OF A CANOLA (BRASSICA NAPUS L.) GLOBAL COLLECTION

Ahasanul Hoque*(1), Mukhlesur Rahman(1)

Department of Plant Sciences, North Dakota State University, Fargo, ND

Broadening of genetic diversity in canola is important for sustainable breeding program. Recent domestication history coupled with breeding efforts focused on few traits is the main reason for low diversity of canola. The NDSU canola breeding program aimed to increase genetic diversity of its parental stock by incorporating diverse genotypes. Therefore, the objective of this study was to survey the population structure, examine genetic diversity patterns within and among different structural groups, and measure the extent of linkage disequilibrium (LD) of 383 canola germplasm using 8502 SNP markers. The core collection used in this study was divided into five subpopulations (P1 to P5) with obvious geographic and growth habit-related patterns. The winter (European), semi-winter (Asian), spring (NDSU and mixed origin) and rutabaga types were distinctly grouped from each other. A moderate genetic diversity (average H = 0.22 and I = 0.34) was identified among subpopulations. The pairwise Fst comparison revealed that rutabaga type showed highest divergence (Fst > 0.3) with spring and winter types. High divergence was also found between winter and spring types. Overall, mean LD was 0.03 and it decayed to its half maximum within < 45 kb distance. The genome C always showed higher LD blocks (< 93 kb), than A genome (< 21 kb). Our study confirms that rutabaga type is the best resource to broaden the genetic base of NDSU collection. Hybridization between spring and winter, semi-winter type is also helpful to maximize genetic diversity. Low genetic differentiation between spring type subpopulations (P4 and P3) will accelerate favorable allele accumulation in elite lines. The NJ-tree and kinship matrix will assist to identify duplicates and distinct genotypes to utilize in hybridization. The LD patterns inform genotyping decisions for future association mapping studies to ensure the identification of a sufficient number of molecular markers to tag all linkage blocks.

Support: No financial support

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LaVallie
Graduate
Talk

ANALYSIS OF ORGANICS AND NONCONDENSABLE GASES PRESENT IN SUBCRITICAL WATER-TREATED ALKALI LIGNIN

Audrey LaVallie* and Alena Kubátová

Chemistry, University of North Dakota, Grand Forks

Alkali lignin, a recalcitrant biomass material produced as a waste product of paper and biofuel industries, on the order of 70 million tons annually worldwide, also has potential as a sustainable source of phenolics which may have applications in chemical, agricultural and manufacturing industries. Our study focused on the characterization of lignin subjected to subcritical water (SW) treatment in comparison to untreated alkali lignin.

The investigation served as a baseline study of lignin SW treatment, of use as a comparison for studies combining SW treatment with additional reagents or catalysts. Mass distribution of breakdown products by thermal desorption and pyrolytic processes, and identification of major organic and gas components were determined via thermal carbon analysis (TCA), liquid-liquid extraction gas chromatography-mass spectrometry (GC-MS), thermal desorption-pyrolysis-gas chromatography- mass spectrometry (TD-Py-GC-MS), and gel permeation chromatography (GPC) analyses. The TCA results showed good mass balance closure for SW treated lignin residue and liquid fractions.

SW treatment at 300 °C resulted in monomeric species amounts at a maximum of 6.0 wt% carbon of initial lignin carbon for unfiltered SW treated samples. Dimeric species were scant in the liquid fractions of SW treated samples whereas in the untreated lignin one-fourth of GC-elutable organic species were dimers. Also, a significant fraction appeared in TD-Py-GC-MS as CO2 and other gas phase species, i.e., products of pyrolysis. The solid fraction also showed partial degradation compared to untreated lignin as evidenced through GPC molecular weights.

In conclusion, SW treatment showed optimal monomer yield/repolymerization balance at about 300 °C, with substantial oligomer yield in the liquid fraction via TCA analysis, and degradation indicated in the solid fraction; monomeric yield here should be compared to studies combining SW treatment with other degradation methods.

Support: This work is based upon Kubátová's group tasks supported by the NSF Research Experience for Undergraduates under Grant No. CHE 1460825 and CHE1156584, as well as NSF EPSCoR Track-1 Cooperative Agreement OIA-1355466; DakotaBioCon Grant No. IIA-1330840 and IIA-1330842; and CSMS IIA-1355466

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Martens
Graduate
Talk

AGENTS OF DARKNESS: UNDERSTANDING THE ETIOLOGICAL AGENTS OF BLACK SPOT DISEASE IN FISH

Jakson R. Martens, Tyler J. Achatz, Vasyl V. Tkach

University of North Dakota

Fish-eating birds serve as definitive hosts for a broad variety of digeneans, many of which use fish as intermediate hosts. Some of them encyst in fish skin and cause "black spot disease" throughout the United States and elsewhere in the world. The disease is characterized by raised, black nodules on the skin, fins, and eyes of fish. In cases of high intensity of infection, black spot disease can cause health issues ranging from mobility loss, increased vulnerability to predation and death. This study aims at further elucidating black spot agent identity and diversity, with a primary focus on the genera Uvulifer and Crassiphiala which are the most common agents of black spot disease in the north-central United States. Fishes within the Midwest were surveyed for the presence of black spot agents on their skin and fins. Sequences of mitochondrial cox1 and nuclear ribosomal 28S DNA were used to match the larval stages with morphologically identified adult stages as well as for phylogenetic inferences and analysis of interspecific variation. Adult parasites used in the study were collected from kingfishers collected in the USA and South America. In total, five species-level lineages of Crassiphiala and seven species-level lineages of Uvulifer were found, six of which were identified to species.

Support: DEB1120734 from the National Science Foundation

Joe K. Neel Memorial Award from the University of North Dakota and Willis A. Reid, Jr. Student Research Grant from the American Society of Parasitologists to T.J.A.

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Onwumelu
Graduate
Talk

EXPERIMENTAL INVESTIGATION OF MATURATION PROCESSES AND THEIR IMPACT ON ORGANIC MATTER

Chioma Onwumelu and Stephan Nordeng

Harold Hamm School of Geology and Geological Engineering

Organic material within source rocks consist of extremely complex macromolecules made largely of hydrogen and carbon structures together with a host of other minor components. The process of oil generation involves breaking bonds within these macromolecules to form mobile and soluble (in organic solvents) hydrocarbon fragments that together mix to form mobile crude oil and natural gas or immobile bitumen. Even though the processes and mechanisms of oil generation are exceedingly complex, there is general agreement that overall reaction rates are in agreement with the Arrhenius Equation. The ultimate significance of this study is to experimentally determine the changes that occur in organic matter during maturation, and it involved documenting the change in the organic geochemical properties of the Bakken Shale during maturation and evaluating the hypothesis that there is a secondary compensation effect between Ea and ln(A) (kinetic parameters).
In this study, we utilized artificially matured Bakken samples kept in the oven at 340℃ with an increasing thermal maturity (Tmax 419-445 C). Firstly, the samples were analyzed to obtain the kinetic properties. Secondly, we used scanning electron microscope to describe the modification in texture and distribution of organic matter. We then used reflected light microscope for characterization of visible kerogen.
Results show that geochemical properties such as the total organic carbon content and hydrogen index reduced with increasing thermal maturity. It also shows there exist a secondary compensation effect when Bakken samples are repeatedly analyzed. Results from our study provides the basis for calibrating kinetic parameters (Ea and A), and other organic chemistries and indices to specific degrees of thermal stress. While this study focused on the Bakken Formation in the Williston Basin, the intent is that the methodologies developed can be applicable to other sedimentary basins.

Support: NA

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Reagen
Graduate
Talk

SYNTHESIS OF FLUORESCENT GRAPHENE QUANTUM DOTS FOR IN VITRO CELL IMAGING AND METAL ION DETECTION

Sarah Reagen, Yingfen Wu, Xiao Liu, Rahul Shahni, Jacob Bogenschuetz, Xu Wu, Qianli R. Chu, Nuri Oncel, Jin Zhang, Xiaodong Hou, Colin Combs, Antonio Vasquez, and Julia Xiaojun Zhao

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Graphene quantum dots (GQDs) are a subset of nanoparticles that have peaked recent interest due to their photoluminescence properties, low toxicity and biocompatibility features for bioimaging applications. However, it is still a challenge to prepare highly near-infrared (NIR) fluorescent GQDs using a facile pathway. In this study, NIR GQDs were synthesized from a biomass-derived organic molecule cis-cyclobutane-3,4-di(furan-2-yl)cyclobutane-1,2-dicarboxylic acid via one-step pyrolysis. The resulting GQDs were then characterized by various analytical methods such as absorption spectroscopy, fluorescence spectroscopy, dynamic light scattering (DLS), high resolution transmission electron microscopy (HRTEM), Fourier transform infrared spectroscopy (FT-IR), X-ray diffraction (XRD) and X-ray photoelectron spectroscopy (XPS). Moreover, the photostability and stability over pH were also investigated, which indicated the excellent stability of the prepared GQDs. Additionally, two peaks were found in the emission spectra of the GQDs, one of which was located at about 860 nm. Incubating the GQDs with RAW 246.7 cells resulted in the GQDs entering the cells through endocytosis and thus could be used as fluorescent bioimaging agents. Moreover, the GQDs depicted relatively enhanced fluorescence when treated with different metal ions, indicating that the GQDs could be used for metal ion detection in biological samples as well.

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Sun
Graduate
Talk

ONE-POT SYNTHESIS OF RU/RGO NANOCATALYST FOR ELECTROCHEMICAL SYNTHESIS OF AMMONIA

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Ammonia production consumes significant energy supply and causes enormous CO2 emission globally. To lower energy consumption and CO2 emission, in this work, a facile, environmentally friendly, and cost-effective one-pot synthetic method for Ru-based nanocatalyst has been developed using rGO as matrix. The developed nanocatalyst can reduce the energy usage through electrochemical synthesis of ammonia at ambient conditions. The synthesis of the nanocatalyst was based on a single step of reduction of RuCl3 into Ru-NPs and GO into rGO using glucose as the reducing agent. The developed ruthenium-based nanocatalyst was characterized using TEM, HRTEM, SEM, EDS, UV-Vis, XRD, FTIR, and DLS. The results demonstrated the morphology of Ru/rGO nanocatalyst with a size of 1.93 ± 0.24 nm and the metal content of 20 wt.%. Bulk electrolysis measurements were conducted on the thin-layer electrodes at various cathodic potentials in N2-saturated 0.1 M H2SO4 electrolyte. Based on the chronoamperometric measurements, the maximum F.E. of 5.3 % for ammonia production on the nanostructured Ru/rGO catalyst was achieved at the potential of -0.20 V vs. RHE. This electrocatalyst attains significantly high ammonia production rate of 29.20 μg/(h•mg(cat.)), which is paving the way to the scaling-up electrochemical ammonia synthesis. Compared to the reported nitrogen and phosphorus co-doped hierarchical porous carbon (NPC) electrocatalysts for the nitrogen reduction reaction (NRR) with the F.E and ammonia production rate reached 4.2% and 0.97 μg/(h•mg(cat.)). Our results clearly demonstrated the feasibility of reducing N2 into ammonia under ambient conditions using the nanostructured Ru/rGO electrocatalyst.

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Wu
Graduate
Talk

PEI-COATED Fe3+ QUANTUM DOTS FOR ULTRASENSITIVE DETECTION OF H2O2 AND GLUCOSE

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High blood sugar levels will result in diabetes and other serious diseases. Therefore, finding an effective way to determine the blood glucose concentration is of great importance. In this paper, a new graphene quantum dots (GQDs-Fe)with size smaller than 10 nm and zeta potential around 10 mV (measured by dynamic light scattering method) were successfully synthesized with Fe(III) ion and hydrophilic polyethylenimine (PEI) under 200 ℃ for 15 h to detect H2O2 and glucose. Due to the redox reaction between of Fe(III) ion and H2O2, the concentration of H2O2 would be determined by the variation in fluorescence intensity. However, the existence of H2O2 is produced by the oxidation of glucose, therefore, the detection of glucose can be realized.The optical properties, morphology, and surface functional groups of the newly synthesized GQDs were systematically characterized by analytical spectroscopy methods. Results showed that the GQDs-Fe have adsorption peak, excitation and emission at 334nm, 340nm and 466nm, respectively. Most importantly, the quantum yield of the proposed GQDs-Fe was 70.86%, which was much higher than other GQDs (usually 10-20%). In addition, in order to obtain the optimal detection conditions, the reaction time and pH were optimized. The GQDs-Fe showed a significant decrease in fluorescence with the reaction of H2O2. Under the high performance of Fe(III) oxidization, the newly synthesized GQDs show high potential for its application in H2O2 and glucose detection.

Support: NSF

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POSTDOCTORAL, FACULTY, AND PROFESSIONAL COMMUNICATIONS

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

Haring
Faculty
Talk

TEACHING GENETIC ENGINEERING USING MODERN GENE EDITING IN THE UNDERGRADUATE INSTRUCTIONAL LABORATORY

Angela M. Adsero (1), Wendy A. Larson (2), Trevor A. Baumgartner (2), Timothy M. Wilson (2), and Stuart J. Haring* (1,2)

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Recombinant DNA technology is possible because of four major discoveries: (1) plasmid cloning vectors, (2) identification/purification of restriction enzymes, (3) polymerase chain reaction (PCR) to amplify DNA, and (4) DNA sequencing. Over the past three decades, these discoveries have been adapted and merged with other discoveries to not only allow for sequencing of whole genomes on a chip, but also for the manipulation of genes with relative ease, to the point where these technologies are no longer the limiting factors for disease diagnosis and therapeutics.

The field of recombinant DNA technology is evolving at an amazingly rapid rate. Modern medicine and medical research has also evolved, such that these fields now often require the use of DNA identification and manipulation to identify disease-causing DNA perturbations, to prescribe the best therapeutics (personalized medicine), and/or to provide for more permanent treatment options through targeted gene therapy. Modern agriculture is also taking advantage of gene editing to generate crops resistant to pests and disease in order to increase yields and nutritional value. At NDSU, the undergraduate BIOC 474: Methods of Recombinant DNA Technology course has been using the CRISPR-Cas9 system to practice, from start-to-finish, how one does modern-day gene editing through a semester-long project. Students emerging from this class will have gained fundamental knowledge and first-hand experience in manipulating gene function in living cells. This study outlines the gene-editing strategy used in the class and presents students' results from preliminary studies using CRISPR-Cas9 technology.

Support: Laboratory instructional fees provided by North Dakota State University and additional funding from NSF-CAREER-1253723 to SJH.

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Pruess
Faculty
Talk

TWO NOVEL ANTI-MICROBIALS ARE HEADING TOWARDS COMMERCIALIZATION NDAS PROCEEDINGS

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Despite an array of techniques to reduce bacterial infections, there are still numerous pathogens that act in clinical environments or during food processing and cause infectious diseases. We identified two novel anti-microbials and biofilm inhibitors, β-phenylethylamine (PEA) and ethyl acetoacetic acid (EAA) that inhibit bacterial growth, biofilm biomass, the ATP content of biofilms, and live bacteria within biofilms [1-3].

Two of the current applications include a treatment of ground beef and a model for antibiotic lock treatment in silicone tubing. In the first application, EAA or PEA were mixed with ground beef to reduce spoilage bacteria up to 5 log and externally added E. coli by about 1 log. In the second application, EAA or PEA were flushed through the catheter three times during a two week incubation with pathogenic bacteria. Reductions in bacteria were between 1 and 3 logs.

A patent was published in March of 2019 [4]. This patent is undergoing periodic changes, as recommended by the law team. For commercialization, we are communicating with food processing companies. One experiment has been performed that was requested by several companies and concerned the heating process of the food. We compared the mass spectrograms of heat treated with untreated EAA and PEA samples and did not see any difference. At this time, we conclude that the two components do not get degraded during the heating process to a compound that could possibly be more toxic than the original chemicals. For the future, we will keep following such suggestions and look forward to commercializing these two novel anti-microbials in the food processing area.

[1] B.M. Prüß. 2019. Patent RFT-559, File Date 09/21/2018. Published.
[2] Schroeder, M., S.M. Horne, and B.M. Prüß. 2018. J. Med. Microbiol. 67:1778-1788.
[3] Horne, S.M., M. Schroeder, J. Murphy, and B.M. Prüß. 2018.. Lett. Appl. Microbiol. 66:329-339.
[4] Lynnes, T., S.M. Horne, and B.M. Prüß. 2014. Meat Science 96:165-171.

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UNDERGRADUATE POSTER COMMUNICATIONS

Elshanbary
Undergraduate
Poster

RAPID SYNTHESIS OF N-[1-(4-CYANOPHENYL)ETHYL]-N-METHYLFORMAMIDE

Hassan Elshanbary, Lioudmila I. Bobyleva, MS, and Mikhail M. Bobylev, PhD*

Minot State University

Background: Recently, we developed a rapid procedure for the Leuckart reaction and successfully applied it for the synthesis of substituted N-benzyl-N-methylformamides. Interestingly, in the reaction conducted on 4-cyanobenzaldehyde, a large amount of a by-product, of N,N-di-(4-cyanobenzyl)-N-methylamine was produced with an isolated yield of 37.5%. N-(4-cyanobenzyl)-N-methylformamide was produced with an isolated yield of 46.5%.

Hypothesis: Due to the presence of a methyl group attached to the carbonyl, the reaction conducted on 4-cyanoacetophenone will proceed slower and produce a higher yield of N-[1-(4-cyanophenyl)ethyl]-N-methylformamide and a lower yield of N,N-di[1-(4-cyanophenyl)ethyl]-N-methylamine.

Methods: The reaction was conducted on 10 mmol scale at 187-190 ºC. Column chromatography was used for the isolation of the products of the reaction. NMR-spectroscopy and elemental analysis were used to determine the structures of the products.

Results: The reaction was completed in 40 minutes compared to 10 minutes for the reaction with 4-cyanobenzaldehyde. The isolated yield of N-[1-(4-cyanophenyl)ethyl]-N-methylformamide was 82.48%. N,N-di[1-(4-cyanophenyl)ethyl]-N-methylamine was not isolated or detected.

Conclusions: The results of the reaction support the initial hypothesis. The reaction provides a new method for the synthesis of N-[1-(4-cyanophenyl)ethyl]-N-methylformamide.

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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Fleck
Undergraduate
Poster

NEUROTRANSMITTER EFFECT ON E.COLI GROWTH AND EXPRESSION OF FLAGELLAR GENES

William Fleck, Shelley M. Horne Birgit M. Pruess

North Dakota State University

Objective: Determine the effect of the trace amines β-phenylethylamine (PEA), tyramine, and tryptamine on transcription of the flagellar master regulator operon flhD and the gene for the flagellar specific sigma factor fliA in the non-pathogenic Escherichia coli (E. coli) strain AJW678.

Methods: The flhD promoter was fused to the open reading frame for green fluorescent protein (GFP) to measure flhD transcription in response to the trace amines. In separate experiments, the fliA promoter was fused. The effect of the trace amine was studied at increasing concentrations up to 500 µg/mL. The green fluorescence and OD600 were measured over a 24 hour period with readings every hour. This was done for E. coli with the flhD::gfp for seven replicates and the E. coli with fliA::gfp for three replicates. For each time point, the green fluorescence (RFU) was divided by OD600. The rate of increase was determined between 5 and 15 hours ((RFU/OD600)/hr). The averages and confidence intervals were determined across the respective replicates. If the 95% confidence interval did not intersect the mean of the control group, data was considered statistically significantly different. However, this did not necessarily indicate a biologically relevant difference.

Results: Tyramine had no effect on flhD/fliA transcription at any concentration. At 500 µg/mL, tryptamine and PEA significantly decreased flhD/fliA transcription. For tryptamine, at 100 µg/mL, there was a statistically significant increase of 15.9% but further research is needed to determine if there was a biologically relevant difference as well.

Conclusions: None of the trace amines exerted any significant effect on transcription of flhD and fliA until a concentration of 500 µg/mL (tryptamine and PEA). This implies that PEA, tyramine, and tryptamine do not not impact flagella expression at lower concentrations.

Support: ND EPSCoR

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Garcia Michel
Undergraduate
Poster

DIRECTIONALITY IN PATHWAYS OF INFORMATION FLOW FOR ALLOSTERIC COMMUNICATION IN ERK2

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Extracellular signal-regulated kinase 2 (ERK2) is a major regulator in cell proliferation and is an important target for potential drugs treating cancer, Alzheimer's disease, and dwarfism. Our research focuses on studying communication pathways in ERK2 to provide an insight into dynamics within the protein and its interactions with other complexes. This will result in a better understanding of mutations and their relationship to disease. Current methods for calculating transfer entropy require very long simulations and approximate methods are not applicable in mutation studies. Our new method calculates transfer entropy from the variance-covariance matrix of protein fluctuations derived from molecular dynamics simulations and provides rapid estimation of transfer entropy. We test our method on a series of molecular dynamics simulations of ERK2 in its active and inactive states and four inactive state mutants that are known to auto-activate. We find that the inactive state shows involvement of the conserved DFG site that is not present in the active state, consistent with a wealth of kinase literature. The active state shows that the ATP binding site drives the substrate binding sites, providing insights into the mechanism for binding and reaction of the kinase. Findings from our computational data match existing literature on ERK2, confirming that our new method can be used for rapid and reliable calculation of transfer entropy and successfully applied to mutation studies. Consistent with other Molecular Dynamic simulations and Network Models. We also present a new understanding of the role of the N-terminal region in the allosteric communication pathways of ERK2. These insights will contribute to other clinical research groups in the areas of drug-design for cancer and other diseases.

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Hanson
Undergraduate
Poster

CHEMISTRY OF INHALABLE PARTICLES FROM WELDING FUMES AT NUETA HIDATSA SAHNISH COLLEGE, NEW TOWN, ND

Tyler Hanson* (1), Janna Steen (2), Lizette Alvarez (2), James Medieros (2), Montse Rodriguez (2), Kerry Hartmann (2)(3) and Bernhardt Saini-Eidukat (1)

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Chemical characteristics of indoor particles generated in the shop area used to teach welding at Nueta Hidatsa Sahnish College in New Town, North Dakota were measured. This research aims to quantify the amount and composition of particulate matter (PM) generated during welding instruction and to measure changes in air quality before and after installation of a new air filtration system in the shop area. Here, we present information on the chemistry of PM, which is important as the particles may carry potentially heavy metals and elements that are fine enough to be inhaled.

MiniVol TAS portable air samplers (Air metrics, Springfield, OR, USA) were strategically placed in various locations in and out of the welding shop. Depending on the type of impactor used, PM2.5 or PM10 samples were collected. PM10 are particles with an aerodynamic diameter between 2.5 to 10 micrometers, while PM2.5 have aerodynamic diameter less than 2.5 micrometers. High purity 47mm diam circular Millipore fiber SiO2 filters (pore size = 2.2 micrometer) were used to collect material with the TAS operating at 0.005 m3/min (5 liter/min). Chemistry was analyzed using scanning electron microscopy energy dispersive spectroscopy (SEM-EDS) of particles on filters and Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS) of acid digested filters.

SEM-EDS analysis showed the air particulate chemistry was widely variable on a small scale. Analyses across three samples taken pre renovation showed most of the material is (average values in wt.%, standard deviation): O (34.1, 7.1), Si (23.5, 13.4), Fe (17.6, 11.2), Ca (7.1, 5.7), K (3.9, 4.2), Mn (3.8, 2.7), Na (3.6, 2.1), and C (3.4, 6.3) (n=28). Smaller amounts of F, Zn, Ti, Al, P, Mg, S, Mo, and Cl were detected. Analysis showed that post renovation, significantly lower concentrations of trace elements such as Pb, As, Co, Sb and others were present in the PM, and a few other trace elements were no longer detectable.

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King
Undergraduate
Poster

EXPRESSION AND PURIFICATION OF A THERAPEUTICALLY RELEVANT MONOCLONAL ANTIBODY FROM CHO CELLS

Madison King; Estelle Leclerc

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The receptor for advanced glycation endproducts (RAGE) is a cell surface receptor that becomes activated in inflamed tissues. RAGE activation is mainly triggered by the interaction with extracellular ligands. In the last several years, our lab has generated murine monoclonal antibodies that bind to the extracellular part of RAGE and block the interaction with RAGE ligands. One of these antibodies, IgG 2A11, was shown to be therapeutically promising in two animal models of cancer, pancreatic cancer and melanoma. IgG 2A11 was initially purified from hybridoma. However, we observed that the expression yield of the antibody decreased overtime. To overcome this issue, we cloned the antibody heavy and light chains into plasmids that allowed expression by transient transfection in mammalian cells. We describe here the optimization of expression and purification of IgG 2A11 from Chinese Hamster Ovary Cells (CHO).

Support: This work was supported in part by the College of Health Professions at NDSU and by a DaCCoTA Pilot Award from the National Institute of General Medicine of the National Institutes of Health under grant number U54 GM128729.

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Murphy
Undergraduate
Poster

EXPRESSION, PURIFICATION AND CHARACTERIZATION OF A NANOBODY WITH ANTI-MOUSE IgG SPECIFICITY

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Nanobodies are single domain antibodies with binding properties similar to traditional full-size IgG antibodies but they are much smaller in molecular size. There is great potential for nanobodies to replace IgG antibodies in biomedical research and medical diagnostic applications. Beyond replacing animal derived IgG antibodies for ethical and animal welfare reasons, nanobodies offer scientifically important advantages for super-resolution microscopy and in immunofluorescence applications.

This study evaluated the feasibility of expressing, purifying, characterizing and using a nanobody in our laboratory. The project was also intended to provide hands-on research laboratory experience for a NDSU undergraduate student (K.M.) and to introduce a Fargo high school student (M.C.V.) to research through an internship.

Recombinant expression of the nanobody in E.coli was optimized in terms of media composition, bacterial growth temperature and induction of gene expression. It was found that expression in a carbon rich, buffered, autoinduction media at 25°C resulted in excellent yield of soluble nanobody. The expressed protein was purified with a two-step chromatographic protocol. The first step took advantage of an engineered poly-histidine tag for metal-chelate affinity chromatography and was followed by an ion exchange chromatography step, which yielded the primary target protein with excellent purity.

The nanobody was then labeled with a fluorescein-5-maleimid. The engineered fusion tag was removed with a protease that was also expressed and purified in the laboratory.

The fluorescent-labeled nanobody was characterized for its ability to specifically bind to the kappa light chain of mouse IgG antibodies and its performance in immunofluorescence imaging was compared to a commercial full-size IgG antibody.

The results indicate that nanobodies are an attractive alternative to full-size IgG secondary antibodies.

Support: The project was supported by the NDSU Department of Pharmaceutical Sciences

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Scott
Undergraduate
Poster

RAPID SYNTHESIS OF N-[1-(4-METHOXYPHENYL)ETHYL]-N-METHYLFORMAMIDE

Christopher M. Scott, Lioudmila I. Bobyleva, MS, and Mikhail M. Bobylev, PhD

Minot State University

Background: Recently, we developed a rapid procedure for the Leuckart reaction and successfully applied it to the synthesis of substituted N-benzyl-N-methylformamide. Interestingly, in the reaction conducted on 4-methoxybenzaldehyde, a large amount of the byproduct, N,N-di-(4-methoxybenzyl)-N-methylamine, was produced with an isolated yield of 31.3%. N-(4-methoxybenzyl)-N-methylformamide was produced with an isolated yield of 49.3%.

Hypothesis: Due to the presence of a methyl group attached to the carbonyl, the reaction conducted on 4-methoxyacetophenone will proceed slower and produce a higher yield of N-[1-(4-methoxyphenyl)- ethyl]-N-methylformamide and a lower yield of N,N-di-[1-(4-methoxyphenyl)ethyl]-N-methylamine.

Methods: The reaction was conducted on a 10mmol scale at 187-198ºC. Column chromatography was used for the isolation of the products of the reaction. NMR-spectroscopy and elemental analysis were used to determine the structures of the products.

Results: The reaction was completed in 60 minutes compared to 10 minutes for the reaction with 4-methoxybenzaldehyde. The isolated yield of N-[1-(4-methoxyphenyl)ethyl]-N-methylformamide was 85.1%. N,N-di-[1-(4-methoxy-phenyl)-ethyl]-N-methylamine was not detected or isolated.

Conclusions: The results of the reaction support the initial hypothesis. The reaction provides a new method for the synthesis of N-[1-(4-methoxyphenyl)ethyl]-N-methylformamide.

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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Simons
Undergraduate
Poster

RAPID SYNTHESIS OF N-METHYL-N,N-DI-(3-NITROBENZYL)AMINE

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Background: Recently, we developed a rapid procedure for the synthesis of substituted N-benzyl-N-methylformamides. Interestingly, in the reaction conducted on 3-nitrobenzaldehyde, a large amount of a by-product, N-methyl-N,N-di-(3-nitrobenzyl)amine was produced with an isolated yield of 30.5%. N-methyl-N-(3-nitrobenzyl)formamide was produced with an isolated yield of 42.6%.

Hypothesis: Increasing the molar ratio of 3-nitrobenzaldehyde to N-methylformamide (from 1:50 to 1:2) should produce a higher yield of the respective dibenzyl product and a lower yield of the respective monobenzyl product.

Methods: The reaction was conducted on a 10 mmol scale at 169-175℃. Column chromatography was used for the isolation of the products. NMR-spectroscopy and elemental analysis were used to determine the structures of the products.

Results: The reaction was completed in 20 minutes. The isolated yields of N-methyl-N,N-di-(3-nitrobenzyl)amine and N-methyl-N-(3-nitrobenzyl)formamide were 65.31% and 34.07%, respectively. The ratio of the yield of the dibenzyl product to the yield of the monobenzyl product shifted from 1:0.72 to 1.92:1.

Conclusions: The results of the reaction support the initial hypothesis. The reaction provides a new method for the synthesis of N-methyl-N,N-di-(3-nitrobenzyl)amine.

Support: 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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Vick
Undergraduate
Poster

RAPID SYNTHESIS OF N-METHYL-N-[1-(4-NITROPHENYL)ETHYL]FORMAMIDE

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Minot State University

Background: Recently, we developed a rapid procedure for the Leuckart reaction and successfully applied it for the synthesis of substituted N-benzyl-N-methylformamides. Interestingly, in the reaction conducted on 4-nitrobenzaldehyde, a large amount of a by-product, of N-methyl-N,N-di-(4-nitrobenzyl)amine was produced with an isolated yield of 27.7%. N-methyl-N-(4-nitrobenzyl)formamide was produced with an isolated yield of 60.2%.

Hypothesis: Due to the presence of a methyl group attached to the carbonyl, the reaction conducted on 4-nitroacetophenone will proceed slower and produce a higher yield of N-methyl-N-[1-(4-nitrophenyl)ethyl]formamide and a lower yield of N-methyl-N,N-di-[1-(4-nitrophenyl)ethyl]amine.

Methods: The reaction was conducted on 10 mmol scale at 186-191 ºC. Column chromatography was used for the isolation of the products of the reaction. NMR-spectroscopy and elemental analysis were used to determine the structures of the products.

Results: The reaction was completed in 30 minutes compared to 10 minutes for the reaction with 4-nitrobenzaldehyde. The isolated yield of N-methyl-N-[1-(4-nitrophenyl)ethyl]formamide was 85.8%. N-methyl-N,N-di-[1-(4-nitrophenyl)ethyl]amine was not isolated or detected.

Conclusions: The results of the reaction support the initial hypothesis. The reaction provides a new method for the synthesis of N-methyl-N-[1-(4-nitrophenyl)ethyl]formamide.

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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Winburn
Undergraduate
Poster

RAPID SYNTHESIS OF N-[1-(2,4-DICHLOROPHENYL)ETHYL]-N-METHYLFORMAMIDE

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Minot State University

Background: Recently, we developed a rapid procedure for the Leuckart reaction and successfully applied it for the synthesis of substituted N-benzyl-N-methylformamides. Interestingly, in the reaction conducted on 2,4-dichlorobenzaldeyhyde, a large amount of a by-product, N,N-di-(2,4-dichlorobenzyl)-N-methylamine, was produced with an isolated yield of 35.7%. N-(2,4-dichlorobenzyl)-N-methylformamide was produced as the main product with an isolated yield of 44.2%.

Hypothesis: Due to the presence of a methyl group attached to the carbonyl, the reaction on 2,4-dichloroacetophenone will proceed slower and produce a higher yield of N-[1-(2,4-dichlorophenyl)ethyl]-N-methylformamide and a lower yield of N,N-di[1-(2,4-dichlorphenyl)ethyl]-N-methylamine.

Methods: The reaction was conducted on a 10 mmol scale at 184-188 °C. Column chromatography was used for the isolation of the products of the reaction. NMR-spectroscopy and elemental analysis were used to determine the structures of the products.

Results: The reaction was completed in 50 minutes compared to 10 minutes for the reaction with 2,4-dichlorobenzaldeyhyde. The isolated yield of N-[1-(2,4-dichlorophenyl)ethyl]-N-methylformamide was quantitative. N,N-di[1-(2,4-dichlorphenyl)ethyl]-N-methylamine was not isolated or detected.

Conclusions: The results of the reaction support the initial hypothesis. The reaction provides a new method for the synthesis of N-[1-(2,4-dichlorophenyl)ethyl]-N-methylformamide.

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 POSTER COMMUNICATIONS

Archer
Graduate
Poster

EFFECT OF IN-ROW PLANT SPACING ON CANNABIS SATIVA L. 'CHERRY WINE' AND 'SPECIAL SAUCE'

Ryan Archer*, Andrej Svyantek, Harlene Hatterman-Valenti, Collin Auwarter

Plant Sciences, North Dakota State University, Fargo, ND

The objective of this study was to determine optimal in-row spacing for various CBD hemp genotypes. The effect of genotype and plant spacing (meters between plants within row) on post-freeze harvest metrics for 'Cherry Wine' and 'Special Sauce' hemp was observed.

The observation consisted of two treatments (genotype and spacing), two replicates, four separate in-row spacings, and two genotypes. Plants were spaced 2-, 3-, 4-, and 5-meters apart in-row.

The main effect genotype was significant for all harvest metrics except whole plant biomass and yield per hectare. Significant linear trends for in-row spacing were detected for trunk caliper, mass of branching laterals, mass of trunk, and whole plant mass. No genotype/spacing interactions were detected at harvest. Whole plant biomass for individual plants showed a positive linear trend with spacing. When accounting for planting density, there was no significant trend with spacing. The findings suggest that plants grew larger and yielded more marketable material when spaced further apart. This finding informs growers of in-row spacing and canopy compensation, potentially saving them money on nursery and seed costs, as well as planting labor in their own cropping systems.

Support: No financial support was provided for this work.

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Bogenrief
Graduate
Poster

PRODUCTIVITY OF BOK CHOY (BRASSICA RAPA L. SSP. CHINENSIS) UNDER DIFFERENT IRRIGATION REGIMES

Sarah Bogenrief, Andrej Svyantek, Matthew Brooke, Collin Auwarter, Harlene Hatterman-Valenti

North Dakota State University, Department of Plant Sciences

Efficient water use in crop production is becoming increasingly important as freshwater becomes scarce worldwide. Excessive irrigation can reduce yield through nutrient leaching, while inadequate irrigation reduces production through water stress. Drip irrigation combined with effective irrigation practices can reduce water requirements, while maintaining high yields and crop quality. Bok choy (Brassica rapa L. ssp. chinensis) is a cruciferous vegetable that has shown to benefit from supplemental irrigation. Bok choy drip irrigation trials were conducted in 2019 and 2020 at the NDSU Horticultural Research Farm in plastic mulch. Each experiment was planted as an RCBD with split plot arrangement and three replications. Two genotypes ('Mei Qing Choi', 'Joi Choi') and three irrigation rates (low, medium, high) were utilized in both studies. In 2019, both genotypes experienced greatest yield, width and height under a medium irrigation regime in two of three successive harvests. 'Joi Choi' yielded significantly greater than 'Mei Qing Choi' in 2020, but irrigation response was inconsistent. This variability could be attributed to many factors including, but not limited to, excessive flea beetle damage, field variability and inconsistent response to irrigation.

Support: n/a

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Han
Graduate
Poster

CYSTEINE DETERMINATION BASED ON FLUORESCENCE RESONANCE ENERGY TRANSFER OF AN ASSEMBLED NANOHYBRID

Juan Han, Julia Xiaojun Zhao*, David T. Pierce*

Department of Chemistry, University of North Dakota, Grand Forks, ND, 58202

We have developed a nanohybrid using gold nanoclusters (AuNCs) and conjugated polyvinylcarbazole polymer (PVK) nanoparticles that demonstrates a strong fluorescence resonance energy transfer (FRET). The hybrid was characterized using transmission electron microscopy (TEM), inductively coupled plasma-mass spectrometry (ICP-MS), and fluorescence spectrometry. Standard fluorescence measurements of the nanohybrid confirm enhanced AuNC fluorescence quantum yield (QY) from 1 % to 3 % through FRET with the PVK nanoparticles. Fluorescence lifetime decay measurements indicate a 59 % FRET efficiency. Furthermore, the fluorescent nanohybrid is sensitive to cysteine concentration though a quenching process and can be used to determine cysteine over a dynamic range of 0.5 uM to 450 uM. The limit of detection for determination of cysteine is achieved to as low as 0.24 uM. Therefore, the nanohybrid has a potential for determination of other biomolecules.

Support: This work was supported by the NSF grant CHE 1709160 and NSF Cooperative Agreement Award OIA-1946202.

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Kadium
Graduate
Poster

ANALYSIS OF DORMANCY ACCLIMATION RESPONSE IN INCOMPLETE DIALLEL POPULATION REPRESENTING NDSU-GGEP

Venkateswara Rao Kadium,* Andrej Svyantek, John Stenger, Sarah Bogenrief, Collin Auwarter, and Harlene Hatterman-Valenti

NORTH DAKOTA STATE UNIVERSITY

Early wood formation during dormancy acclimation is one of the important traits for the grapevine breeders to develop genotypes suitable to the North American continental climate. Periderm formation and maturation of buds on the cane greatly influence the grapevine freezing tolerance during winter. For the survival and consistency in yields over the year's grapevines need to be adapted to the regional environments with short growing seasons consisting of <150 frost free days and extreme low winter temperatures. Wood formation during acclimation is studied using an incomplete Diallel population within the North Dakota State University Grape Germplasm Enhancement Project (NDSU GGEP) containing individuals that are crosses between parents ND.213 (Alpenglow × C14), SKND.009.41 (Saskatchewan V. riparia accession Riparia L × V. vinifera cv. Perle de Csaba) and ND.054.27 (Frontenac gris × Adalmina). Traits like number of periderm encompassing, mature and total nodes on the canes were monitored weekly on the fruiting genotypes (230) of the population starting from 11th Sep until 15th Oct 2020 for a total of 6 phenotyping events. Evaluation of phenotypic data during the first frost event in Fargo, ND (09/17/20; Photoperiod 12:25 hr.) showed variation for mean periderm encompassing nodes between the subpopulations of the Diallel. Genotypes of the cross SKND.009.41 × ND.054.27 had the greatest mean number of periderm nodes (11.1) while cross ND.054.27 × ND.213 had the fewest (8.7). V.vinifera background in the SKND.009.41 helps in better performance of individuals derived from it. Our further work involving genotyping by sequencing (GBS) of population and marker development to perform QTL analysis to find out genomic regions influencing these traits will help in improving breeding lines for critical fall acclimation traits via marker assisted selection in the NDSU-GGEP.

Support: Specialty Crop Block Grant Program (SCBGP)

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Rana
Graduate
Poster

SEASON EXTENSION USING SUPPLEMENTAL HEAT IN A NORTH DAKOTA HIGH TUNNEL FOR SNAP BEAN AND BASIL

Binu Rana*(1) Harlene Hatterman-Valenti(1)

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The Northern Great Plains is characterized by brief, cool growing seasons. North Dakota farmers have approximately 130 frost free days, limiting their commercial production options. High tunnel and supplemental heating are two growing methods that may extend the growing season for crops. To investigate different methods for season extension, a planting date (3) by low tunnel (3) supplemental soil heat (2) by species (2) by cultivars (2) factorial randomized complete block design experiment with two replications was initiated at the North Dakota State University Horticultural Research Farm. Management factors examined included three planting dates at 3 weeks interval, low tunnel coverings (clear plastic, light frost blanket, and heavy frost blanket), and supplemental soil heating (untreated and soil heating coils). Plants examined included basil ("Elenora" and "Everleaf") and snap bean ("EZ pick" and "Amethyst Purple"). Soil heating cables were set to shut off at a soil temperature of 23.8°C. Air temperature was monitored with thermistors placed at 20 cm above the soil. Soil temperature was monitored at a depth of 10 cm. Supplemental heating was observed to increase the soil temperature relative to the control. The study revealed that soil heating used resulted in increased plant height for basil. There was a significant effect of row covers on bean yield. The light frost blanket and heavy frost blanket covers produced a greater number of pods in bean crops compared to the plastic cover. The higher yield was observed in the bean and basil crops planted on the first planting date. The results indicate that supplemental soil heating and frost protection allow for productive yields from early planting dates. Local farmers taking advantage of these season extending techniques may be able to harvest a more diverse array of produce to regional markets earlier in the season.

Support: Specialty Crop Block Grant Program

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Sun
Graduate
Poster

FRET-BASED PVK@SiQDs NANOCOMPOSITE FOR ENHANCING QUANTUM YIELD AND STABILITY

Di Sun, Xu Wu, Diane Darland, Julia Xiaojun Zhao.

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Silicon quantum dots (SiQDs) have been widely developed in recent years. Nontoxicity makes SiQDs a potential alternative to traditional heavy metal based QDs. However, the SiQDs are very unstable and are susceptible to aggregation, which would significantly reduce their quantum yield (QY). In order to improve the stability and fluorescence QY of SiQDs, using highly florescent 𝜋-conjugated polymer PVK we constructed a PVK@SiQDs nanocomposite. A facile one-pot synthetic approach was developed for fabrication of amine group terminated SiQDs, PVK nanoparticles with carboxyl group was synthesized by nanoprecipitation method. As a result, the SiQDs was doped on the surface of PVK nanoparticles by amide bond. In the nanocomposite, the Förster resonance energy transfer (FRET) occurred where the PVK was used as an energy donor to excite SiQDs to emit strong fluorescence and prevent aggregation of SiQDs. The stable and strong fluorescent nanocomposite was developed for bioimaging and biosensing.

Support: This work was supported by the NSF grant CHE 1709160 and NSF Cooperative Agreement Award OIA-1946202. D.C.D. is supported by an NIH COBRE grant as Project Director (2P20GM104360-06A1; P.I. R. Vaughan)

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POSTDOCTORAL, FACULTY, AND PROFESSIONAL POSTER COMMUNICATIONS

Chevalier Plambeck
Professional
Poster

CORE BIOLOGY FACILITY AND RESOURCES AT NDSU

Amber Chevalier Plambeck, Ph.D.

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The Core Biology Facility (CBF) assists researchers by providing equipment and resources that might not otherwise be accessible to the standard laboratory. CBF is equipped with BD Accuri C6 flow cytometers, BD FACSJazz cell sorter, Agilent 2100 Bioanalyzer, BioTek Synergy H1 microplate reader, iBright FL 1500 imaging system, Thermo Nanodrop 2000c, and more. The Accuri C6 flow cytometers analyze cell populations using fluorescent and light scatter detectors. The FACJazz is a flow cytometer with the additional capability of cell sorting. The Bioanalyzer determines size, quantity, integrity, and purity of DNA, RNA, and protein. The Synergy H1 microplate reader determines absorbance, fluorescence, and luminescence of samples in a plate format. The iBright FL 1500 is used to image, document, and quantify/analyze samples on gels and blots. The NanoDrop 2000c determines absorbance of samples at a small volume or in a cuvette. In addition, CBF contains the equipment and resources to perform tissue/cell culture.

CBF is a reasonable fee structure-based facility with the goal of assisting and promoting research not only at NDSU but also throughout the region. If you are interested in touring the facility and/or discussing how the facility may assist in your research, contact Dr. Chevalier Plambeck (amber.chevalier@ndsu.edu, 701-231-5334).

Support: The Center for Protease Research

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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 Member*s.

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)

President

Joseph Collette
Geoscience
Minot State University
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Past-President

Diane Darland
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President-Elect

Mukhlesur Rahman
Plant Sciences
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Secretary

Stuart J. Haring (2019-21)
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Councilor

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Councilor

Julia Xiaojun Zhao (2019-21)
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Councilor

Heidi Super (2019-21)
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Treasurer

Bryan Schmidt (2017-20)
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COMMITTEES OF THE NORTH DAKOTA ACADEMY OF SCIENCE

Executive Committee	Joseph Collette, Minot State University Diane Darland, University of North Dakota Mukhlesur Rahman, North Dakota State University Stuart J. Haring, North Dakota State University Bryan Schmidt, Minot State University Christopher Keller, Minot State University Julia Zhao, University of North Dakota Heidi Super, Minot State University
Editorial Committee	
Education Committee	
Denison Awards Committee	
Necrology Committee	
Nominating Committee	
State Science Advisory Committee	
Resolutions Committee	
Membership Committee	
Audit Committee	
North Dakota Research Foundation Board of Directors	
Historian	Alexey Shipunov, Minot State University

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

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

Year	President	Location
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
2020	Joseph H. Collette III	Minot (Virtual)

MINUTES OF THE NORTH DAKOTA ACADEMY OF SCIENCE

ANNUAL BUSINESS MEETING 2019

The meeting was called to order by President Darland at 4:36 pm, Friday, March 3, 2018.

Discussion of Academy finances began with a submission by Secretary Haring of the costs of the 2019 NDAS Meeting:

Email Renewal	$162.15
Domain Renewal	$105.85
Form Publisher Renewal	$50.00
Name Badges	$18.94
NDSU Printing - *Proceedings*	$321.60
Honorarium - Speaker	$400.00
Travel - Speaker	$686.00
Accommodations - Speaker	$247.08
UND Catering	$3,174.15
UND Room Reservations	$265.00
Earwicker Awards	$800
Denison Awards (Undergraduate)	$450
Denison Awards (Graduate)	$450
Total	$7,130.77

These costs were underwritten in part by a donation of $800 from the Earwicker family and collected registration fees of $4,475.87 (total = $5,275.87).

While presenting the current financial standings, it was noted that the costs of the annual meeting last year were approximately $2,000 greater than revenue, and a similar loss is expected for the current meeting. Discussion on raising registration fees was postponed until the 2020 annual meeting, to allow time for the committee formed in 2018 to investigate investment opportunities on behalf of the academy (Zhao - UND, Best - TMCC, Haring - NDSU, Jyring - BSC, and Lepp - MiSU) to meet and bring forth options that could stabilize the financial bottom line without raising registration.

As of March 8, 2019, the following were accounts and balances held by the Academy:

PayPal	(includes registration fees)	$7,475.87
USBank - Checking	(includes $2,000 deposit from MSU)	$6,422.76
USBank - Savings		$156,197.78
USBank - Savings		$4,546.99
Total		$174,643.40

President-Elect Collette led a discussion of options for the 2020 annual meeting. He provided two possible meeting locations (Minot State University or the ND Science Museum in Bismarck, adjacent to the Capitol building) and three potential dates (November 22nd of 2019, April 3rd of 2020, or April 17th of 2020). Chris Keller moved (seconded by Julia Zhao) to hold

the meeting in Bismarck, contingent on reasonable costs for meeting expenses (location rental, catering, *etc*.). Motion carried. Chris Keller then moved (seconded by Julia Zhao) to hold the meeting on April 3, with April 17th as a contingency date. Motion carried.

Stuart Haring nominated (seconded by Diane Darland) Mukhlesur Rahman (NDSU) for the position of President-Elect. Chris Keller nominated (seconded by Bryan Schmidt) Julia Zhao and Heidi Super for positions as Councilor. Julia Zhao nominated (seconded by Chris Keller) Stuart Haring for the position of Secretary. All nominees were elected by acclamation.

At the 2019 Annual Meeting, in addition to 25 faculty/postdoctoral/graduate/undergraduate posters, there were 6 faculty/professional talks, 21 graduate student talks, and 3 undergraduate student talks. Due to the generosity of the Earwicker family, additional awards were presented. The award winners were:

Graduate Talk - Earwicker Awards

1st	$250	Atrayee Bhattacharya	University of North Dakota
2nd	$200	Ashrifa Ali	University of North Dakota
3rd	$150	Danielle Germundson	University of North Dakota

Poster - Earwicker Awards

1st	$100	Jaylin Solberg	University of North Dakota
1st	$100	Reid Hawkins	North Dakota State University

Undergraduate Talk - A. Rodger Denison Competition

1st	$200	Tess Skinner	Minot State University
2nd	$150	Bikalpa Ghimire	Minot State University
3rd	$100	Brody Burnett	Minot State University

Graduate Talk - A. Rodger Denison Competition

1st	$200	Wen Sun	University of North Dakota
2nd	$150	Mohsen Tahmasebi Nasab	North Dakota State University
3rd	$100	Raquib Hasan	North Dakota State University

The meeting was adjourned at 5:12 PM by President Darland.

Respectfully submitted,
Bryan Schmidt (MiSU)

LIFETIME MEMBERS

F. D. “Bud” Holland
Ron Jyring
Allen Kihm
Bonnie Heidel