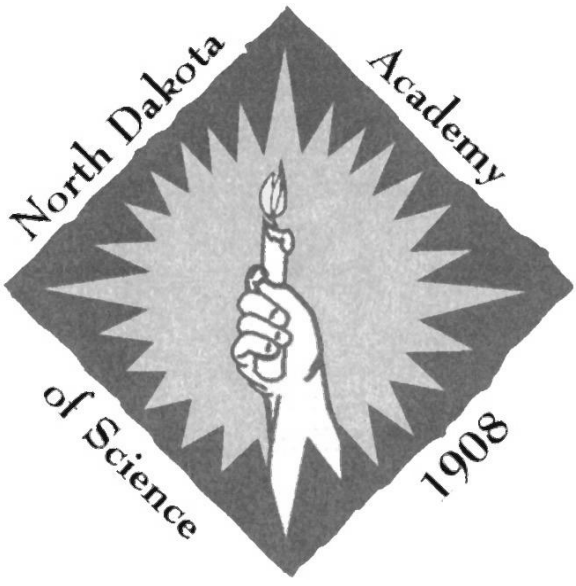
North Dakota Academy of Science

Proceedings of the 108th Annual Meeting

April 2016
Volume 70



Proceedings of the North Dakota Academy of Science (ISBN 0096-9214)

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PROCEEDINGS
OF THE
NORTH DAKOTA ACADEMY OF SCIENCE

Volume 70 April 2016

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

2015-2016

OFFICERS AND MEMBERS OF THE EXECUTIVE COMMITTEE

108th Annual Meeting

April 15-16, 2016

Fargo, North Dakota

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EDITOR'S NOTES

HISTORY

The *Proceedings of the North Dakota Academy of Science* (NDAS) was first published in 1948, with Volume 1 reporting the business and scientific papers presented for the 40th Annual Meeting, May 2-3, 1947. Through Volume 21, the single yearly issue of the *Proceedings* included both abstracts and full papers. Commencing with Volume 22, the *Proceedings* was published in two parts: A, published prior to the Annual Meeting, contained an abstract of each paper to be presented at the meeting, and B, published later, contained full papers by some of the presenters.

In 1979 (Volume 33), the *Proceedings* changed to an 8½ x 11-inch format. Produced from camera-ready copy submitted by authors, it was distributed at the Annual Meeting. As desktop computing became more prevalent, Volumes 51-64 of the *Proceedings* were assembled with desktop publishing software from submitted computer disks. The current volume was assembled from electronic submission of abstracts via email and the *Proceedings* archived online as a portable document file (.pdf).

VOLUME 70 ORGANIZATION

In 2003 the NDAS council voted to accept all abstracts scheduled for presentation at the Annual Meeting. Thus, communications in Volumes 58 to present have not undergone a "typical" peer review. Rather, they provide an accurate reflection of the material presented to the NDAS membership at the Annual Meeting. The presentations in this year's *Proceedings* are presented in four major sections. The first contains the Undergraduate Communications presented as part of the A. Rodger Denison Undergraduate Student Research Competition. The second section comprises the Graduate Communications presented as part of the Denison Graduate Student Research Competition. The third section comprises Professional Communications presented by faculty, post-doctoral, and professional members of the Academy. The final section comprises all abstracts of posters presented at the meeting. Readers may locate communications by looking within the major sections of these *Proceedings* (see Table of Contents) or by referring to the Author Index on page 83.

IN APPRECIATION

The Academy wishes to acknowledge current and *emeritus* members of the Academy who continue to support the mission of the North Dakota Academy of Science Research Foundation through their special gifts. A listing of these supporters accompanies the Financial Report. The Academy also wishes to express its thanks to the presenters of papers at the Annual Meeting, the session chairs, as well as all who have helped in organizing spaces and places, soliciting manuscripts, and compiling of this year's communications.

Stuart J. Haring, President

Bryan Schmidt, Secretary-Treasurer

NDAS LISTSERV

In order to promote better communication between Academy members, an NDUS LISTSERV (NDUS-NDACADSCI@listserv.nodak.edu) was established in 2015. All registrants for the Annual Meeting providing their email address will be added to this listserv. Anyone else wishing to receive communications from the North Dakota Academy of Science, including information on future Annual Meetings, may subscribe.

To Subscribe – send an email (no subject) as follows:

To: LISTSERV@listserv.nodak.edu
Body: SUB NDUS-NDACADSCI yourfirstname yourlastname

You will then receive a confirmation email with further instructions.

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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 approved by a moderator for the listserv to avoid the forwarding of any spam or unsolicited emails.

SCHEDULE

All events will be held on the 2nd Floor (Upper Level) of the NDSU Memorial Union.

Friday, April 15

Time	Arikara		Hidatsa
8:00 AM	REGISTRATION AND BREAKFAST		
8:45 AM	WELCOME AND OPENING REMARKS		
9:00 AM	Choi (U)		Wang (G)
9:20 AM	Parisien (U)		Nayakasinghe (G)
9:40 AM	Karsky (U)		Li (G)
10:00 AM	Senger (U)		Marwarha (P)
10:20 AM		BREAK	
10:40 AM	Illies (U)		Sivapragasam (G)
11:00 AM	Samuelson (U)		Krout (G)
11:20 AM	Zabka (U)		Adsero (G)
11:40 AM	Miller (U)		Keller (P)
12:00 N		LUNCH	
1:00 PM	Takalkar (G)		Bhattacharya (G)
1:20 PM	Xie (G)		Wilson (G)
1:40 PM	Zhou (G)		Malalgoda (G)
2:00 PM	Jabeen (P)		Dhasarathy (P)
2:20 PM		BREAK	
2:40 PM	Kraft (G)		Krueger (G)
3:00 PM	Ahsan (G)		Singh (G)
3:20 PM	Rasulev (P)		Bairagi (P)
3:40 PM	Hartman (P)		Best (P)
4:00 PM	**POSTER SESSION** – Prairie Rose		
5:30 PM	DINNER		
6:30 PM	**BUSINESS MEETING** *All Academy member are encouraged to attend.*		

Saturday, April 16	
Time	**Arikara**
9:00 AM	Miles (U)
9:20 AM	Kitowski (U)
9:40 AM	Baumgartner (G)
10:00 AM	Hassan (U)
10:20 AM	Shipunov (P)
10:40 AM	Pruess (P)
11:15 AM	DENISON COMPETITION JUDGING *All faculty members are encouraged to participate.*
12:00 N	LUNCH
1:00 PM	**AWARD CEREMONY** AND CLOSING REMARKS

PRESENTERS AND PRESENTATION TITLES

ARIKARA

Friday, April 15 – Morning Session

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9:20 AM	Parisien (U)	EXPRESSION OF C-REACTIVE PROTEIN IS INCREASED IN PLACENTAL TISSUE OF WOMEN WITH PRE-ECLAMPSIA
9:40 AM	Karsky (U)	DEVELOPMENT OF A COLORIMETRIC ASSAY FOR THE QUANTIFICATION OF THE PROCINE EPIDEMIC DIARRHEA VIRUS
10:00 AM	Senger (U)	IDENTIFICATION OF CONSERVED PROPERTIES OF RPA2 PHOSPHORYLATION DURING THE DNA DAMAGE RESPONSE
10:20 AM		BREAK
10:40 AM	Illies (U)	DIAGNOSIS OF MOLLUSCAN SPECIES OF JUDITH RIVER FORMATION OF NORTH-CENTRAL MONTANA
11:00 AM	Samuelson (U)	EFFECTS OF CHARGE ON THE PHOSPHORYLATION OF THE RFA2 N-TERMINUS IN YEAST
11:20 AM	Zabka (U)	COMPARISON OF INTERNAL STANDARDS FOR GC-MS ANALYSIS OF CAFFEINE EXTRACTED FROM HUMAN SALIVAL SAMPLES
11:40 AM	Miller (U)	INVESTIGATING THE ROLE OF ALLOSTERIC DISULFIDE BONDS IN THE ANTIBACTERIAL MECHANISM OF LACTOFERRIN

HIDATSA

Friday, April 15 – Morning Session

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ARIKARA

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Friday, April 15 – Afternoon Session

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Saturday, April 16 – Morning Session

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UNDERGRADUATE COMMUNICATIONS

IN THE

A. RODGER DENISON COMPETITION

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

RAPID SYNTHESIS OF N-VANILLYLACETAMIDE

Jin Hee Choi* (U), Lioudmila I. Bobyleva, and Mikhail M. Bobylev

Chemistry, Minot State University, Minot, ND

Background: Recently, we investigated acetamide as an alternative solvent for the Leuckart reaction. In reactions conducted on several substituted benzaldehydes, the respective benzylacetamides were isolated only as minor products with the yields of 10-15%. However, the reaction conducted on 2-hydroxybenzaldehyde produced N-(2-hydroxybenzyl)acetamide as the main product with an isolated yield of 32.9%.

Hypothesis: The presence of a hydroxyl group in benzaldehydes shifts the reaction from producing the respective benzylformamides towards producing the respective benzylacetamides. In this work, this hypothesis was tested on 4-hydroxy-3-methoxybenzaldehyde (vanillin).

Methods: The reaction was conducted on 10 mmol scale at 195^{0}C. Column chromatography was used for the isolation of the products. NMR-spectroscopy and elemental analysis were used to determine the structure of the products.

Results: The reaction was completed in 6 minutes. N-vanillylacetamide was isolated as the main product of the reaction with the yield of 35.8%.

Conclusions: The first one-step synthesis of N-vanillylacetamide from vanillin was conducted. The reaction may lead to a new general method for the synthesis of capsacinoides.

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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EFFECT OF LACTOFERRIN ON YEAST WITH AND WITHOUT IRON

Ismail Hassan* (U) and Bryan Schmidt

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Lactoferrin is an iron-binding protein that has been shown to have antimicrobial activity. Previous studies have suggested that lactoferrin activity is based on its iron binding ability. However, this mechanism fails to explain the reported ability of lactoferrin to inhibit viral infection. We hypothesize that lactoferrin function is mediated by disulfide bonds. To investigate this, we used brewers yeast as a pathogen to assess the effect of lactoferrin under different conditions. Yeast grown in liquid media were subjected to increasing doses of lactoferrin. After incubation, growth was measured by optical density to determine the IC50 value for lactoferrin. Lactoferrin, with or without iron, was unable to inhibit the growth of the yeast within 24 hours. Supplementation of the media with sublethal doses of fungicide to determine any additive effect also failed to inhibit growth. An adhesion assay was used to determine if lactoferrin had any affect on adhesion of yeast to human cells. Cultured adherent squamous carcinoma cells were cultured and coincubated with yeast in the presence or absence of lactoferrin. The cells were then washed with saline solution to remove unattached yeast cells. Remaining cells were detached, plated on agar media and incubated overnight. Colonies were counted after 24 hours to determine yeast adherence to the human cells. The presence of lactoferrin, with or without iron, failed to decrease the adherence. The cumulative results of the activity assay and adherence assay indicate that lactoferrin does not have any immunological effect on brewers yeast.

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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DIAGNOSIS OF MOLLUSCAN SPECIES OF JUDITH RIVER FORMATION OF NORTH-CENTRAL MONTANA

Matt Illies* (U) and Joseph H. Hartman

Harold Hamm School of Geology and Geological Engineering, University of North Dakota, Grand Forks, ND

The Upper Cretaceous Judith River Formation has had a long history of molluscan study beginning with the 1850s expeditions of F.V. Hayden. However, no systematic review of the extensive continental molluscan fauna has been done. This study results in a method to more accurately identify molluscan species and permits stronger paleoecological and chronostratigraphic interpretations. Continental mollusks were collected from shell beds in the Judith River Formation in its type area in the Missouri River Breaks and near Rudyard, Montana. Species' type specimens were photographed at the National Museum of Natural History for measurement and character trait analysis. Specimens were separated by general morphology and measured for selected character traits (e.g., whorl convexity, suture impression). Tables were created that list gastropod and bivalve character traits were tabulated and coded for analysis (e.g., 0 = closed umbilicus; 1 = umbilicate, umbilicus covered; 2 = umbilicus open). Preliminary species identifications and discriminations were based on diagnoses derived from coded type material. Additional specimens from type and other localities were added to the matrix of observations and traits, providing a population of values upon which to derive identifications. Completion of specimen trait studies permits relationships among taxa through the use of analytical techniques (e.g., cluster, cladistics). Studies add depositional environmental, paleoautecological, and paleosynecological information from the context and recognized taxa. The results of this research provide a more rigorous basis to correlate specific deltaic environments to the stratigraphic framework constructed for the Judith River Formation.

Support: This work was financially supported by the Student Experience Fund of the Harold Hamm School of Geology and Geological Engineering of the University of North Dakota.

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DEVELOPMENT OF A COLORIMETRIC ASSAY FOR THE QUANTIFICATION OF THE PORCINE EPIDEMIC DIARRHEA VIRUS

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The porcine epidemic diarrhea virus (PEDV) was first detected in the U.S in 2013 and caused a loss of roughly one quarter of the swine population and several millions of dollars in 1 year. Reliable methods to culture and quantify the virus are essential for vaccine and diagnostic test development. To circumvent the subjective and time consuming nature of current methods, we have developed a colorimetric assay that is inexpensive, convenient, and adaptable to a high-throughput format for the quantification of PEDV virus. The conventional TCID50 and plaque assays were performed by standard methods. After visual assessment of the end point by an operator, a tetrazolium dye called MTT was added to detect cell viability. Optical density (OD) readings were obtained by spectrophotometry. Receiver Operator Characteristics analysis was performed to determine the sensitivity (Se), specificity (Sp) and OD cutoff values for the developed assay. The Sp and Se of the MTT50 assay in comparison to the conventional TCID50 assay were 95% and 81% respectively at a software specified cutoff value of 0.53. The agreement between the tests as determined by a kappa statistic value was 0.83 with a 95% confidence interval of 0.780 to 0.874. Currently, the colorimetric method is being adapted to titrate virus neutralizing antibody responses. The methods developed in this study will significantly reduce the difficulty associated with the manual examination of a large volume of PEDV test.

Support: This study was supported by the Agricultural Products Utilization Committee (APUC) of N. Dakota, the N. Dakota State Board of Agricultural Research (SBARE) and the United States Department of Agriculture (USDA) under project ND02425

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DISCRIMINATION OF PACHYDON MACTRIFORMIS (MEEK AND HAYDEN) IN PALEOCENE STRATA OF NORTH DAKOTA

Stephanie R. Kitowski* (U) and Joseph Hartman

Harold Hamm School of Geology and Geological Engineering, University of North Dakota, Grand Forks, ND

Found associated with other freshwater fossils, *Pachydon mactriformis* was originally assigned to Corbula, occurring at Fort Clark, North Dakota (Meek and Hayden, 1856). Being of the Family Corbulidae, this species was routinely interpreted as marine or brackish. This interpretation appeared confirmed by the identification of this species in the Cannonball Formation in south-central North Dakota (Stanton, 1920). Problems exist, however, in that the isotopically freshwater P. mactriformis co-occurs with freshwater taxa across western North Dakota in the upper part of the continental Fort Union Formation. Thus its long interpreted connection to marine conditions is an invalid hypothesis. The question remains, are the few relatively poorly specimens identified by Stanton as Corbula mactriformis actually Pachydon mactriformis. New field studies by the authors in the Cannonball Formation did not produce new or better specimens. National Museum of Natural History study resulted in rephotographing Stanton's two Cannonball specimens. A trait analysis was conducted drawing from the 60+ corbulid traits established by Anderson and Rooparine (2003) using Cannnonball and a selection from the over 5000 Fort Union specimens of *P. mactriformis* from western North Dakota at UND. Also used were SEM images detailing sculptural features not previously noted. Results to date are necessarily problematic. Internal views are not available of the Cannonball taxon. Cannonball specimens appear less inflated (valve width) and the beaks (apices) are simple (less pointed, less elevated, and less incurved). However, the sample size is miserably small. The working hypothesis is that the corbulid species of the Cannonball and Fort Union Formations are different.

Support: This work was financially supported by the Student Experience Fund of the Harold Hamm School of Geology and Geological Engineering of the University of North Dakota.

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BIOCHEMICAL EVIDENCE IDENTIFYING REGIONS OF RFA2 RESPONSIBLE FOR CHECKPOINT ADAPTATION IN YEAST

Nolan M. Miles* (U) and Stuart J. Haring

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Replication Factor A (RFA) is a heterotrimeric subunit complex that acts as the single-stranded DNA (ssDNA) binding protein in all eukaryotic cells. In response to DNA damage, RFA is phosphorylated on the N-terminus (NT) of the 32 kDa subunit (Rfa2). This phosphorylation is also correlated with the onset of cell cycle checkpoint "adaptation". Checkpoints normally arrest the cell cycle, allowing ample time for cells to repair their DNA. However, during checkpoint adaptation, cells make a "molecular decision" to exit a checkpoint despite the presence of DNA damage. Checkpoint adaptation is thought to be a last-resort mechanism allowing cells to grow and divide, with the negative consequence of increased mutations that potentially lead cellular disease.

Rfa2 phosphorylation is hypothesized to be the factor that signals the cell to exit arrest. To examine this, putative target phosphorylation sites (serines/threonines) within the three subregions of the Rfa2 NT were mutated or deleted. Following DNA damage, activation of a marker for checkpoint formation and adaptation (Rad53) and Rfa2 phosphorylation were examined. In cells where the Rfa2 NT is phosphorylated earlier (or mimics phosphorylation), cells adapt earlier and more efficiently. These studies provided the opportunity to identify which subregion(s) of the Rfa2 NT are important for checkpoint adaptation and results suggest that Rfa2 phosphorylation may actually be driving checkpoint adaptation through Rad53 deactivation.

Support: This work was supported by award NSF-CAREER-1253723 from the National Science Foundation to SJH.

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INVESTIGATING THE ROLE OF ALLOSTERIC DISULFIDE BONDS IN THE ANTIBACTERIAL MECHANISM OF LACTOFERRIN

Suzzanah Miller* (U) and Bryan Schmidt

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Lactoferrin is an iron-binding innate immune protein found in mammalian secretions such as milk. Lactoferrin's antibacterial properties against Escherichia coli were tested to evaluate the role of disulfide bonds in its activity. Activity assays and streak tests on plates treated with lactoferrin failed to inhibit bacterial growth at concentrations up to 40 mg/mL. Preliminary adhesion assays on human tissue cultures of SCC-25 and HT-1080 cell lines indicated that thiol mediators did not affect adhesion in the absence of lactoferrin but that lactoferrin may not inhibit adhesion. A novel adhesion assay which used yeast cells instead of human tissue did not show a decrease in adhesion of bacteria in the presence of holo-lactoferrin. Holo-lactoferrin was unstable in low-ionic strength solutions and precipitated upon standard treatment to remove iron. Results from tests of thiol mediators suggest their inclusion in assays with lactoferrin can be used to test the effect of redox state on lactoferrin's antibacterial activity. The lack of positive data for inhibition of infection indicates any potential activity is governed by a complex set of factors including pH, media composition, bacterial type, and protein conformation. Consideration of these factors is necessary to evaluating lactoferrin's function in physiological settings.

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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EXPRESSION OF C-REACTIVE PROTEIN IS INCREASED IN PLACENTAL TISSUE OF WOMEN WITH PRE-ECLAMPSIA

Ashley Parisien* (U1), Crystal Azure (1), Bethany Davis (2), Cindy Anderson (3), and Lyle Best (1)

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PURPOSE: The etiology of the pregnancy complication, pre-eclampsia (PE), is unknown; but multiple lines of evidence implicate immunologic factors. C-reactive protein (CRP) is a prominent component of the innate immune system. Recently the placenta was found to express CRP and infusion of CRP into pregnant mice has recapitulated various features of PE.

METHODS: Placental tissue from 6 women with PE and 8 with normal pregnancies was obtained. RNA was extracted and cDNA produced using standard methods. Quantitative, real-time PCR using BioRad primers for human CRP and a standard "housekeeping" gene (GAPDH) was used to estimate placental expression of CRP (the Cq value) as a ratio of GAPDH expression (CRP/GAPDH). Each expression run measured SYBR fluorescence in triplicate and Cq values were determined against a standard curve derived from BioRad template standards of known concentration. Student's t test examined possible differences of mean CRP/GAPDH ratios.

RESULTS: There were a total of 22 triplicate runs of CRP/GAPDH expression. Intra-run CV's averaged 1.51%. The mean (SD) CRP/GAPDH ratio was 1.03 (0.024) and 1.14 (0.060) for cases and controls respectively, $p<0.001$.

CONCLUSION: We show that CRP is expressed in placental tissue and that expression is greater relative to a standard reference gene among those with PE compared with normal pregnancies. Our findings are consistent with the single previous investigation of this question.

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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EFFECTS OF CHARGE ON THE PHOSPHORYLATION OF THE RFA2 N-TERMINUS IN YEAST

Brian D. Samuelson* (U) and Stuart J. Haring

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Replication Protein A (RPA) is a three subunit protein complex required for DNA replication, repair/recombination, and cell cycle regulation and is conserved from yeast to humans. In human cells, the medium subunit, Rpa2, is hyper-phosphorylated in response to DNA damage. Its yeast counterpart, Rfa2, is also phosphorylated; however, the phosphorylation detected is significantly less. Interestingly, yeast Rfa2 contains multiple glutamic acid residues found in the N-terminus (NT), suggesting that the reason it is not hyper-phosphorylated to the extent it is in human cells is because the domain in yeast is already quite negatively charged.

Using homologous recombination cloning in yeast, the Rfa2 NT was replaced with four different yeast NTs. Each of the four Rfa2 NT contain all five of the negatively-charged (glutamic acids) and the two positively-charged (arginines) residues mutated to the following: (1) all alanines (neutralize domain), (2) all asparagines (neutralize domain with similarly structured amino acids), (3) all glutamines (neutralize the domain with similarly-structured amino acids that also generate motifs recognized by checkpoint kinases), and (4) lysines and aspartic acids, respectively (complete charge reversal of domain). These are being used to test how the charge and sequence context of the Rfa2 NT affect the level and length of time needed for its phosphorylation and the ability of cells to respond to DNA damage.

Support: This work is supported by award NSF-CAREER-1253723 from the National Science Foundation to SJH.

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IDENTIFICATION OF CONSERVED PROPERTIES OF RPA2 PHOSPHORYLATION DURING THE DNA DAMAGE RESPONSE

Barbara L. Senger (U) and Stuart J. Haring

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Replication Protein A (RPA) is a heterotrimeric complex in all eukaryotes that is essential for DNA replication, repair/recombination, and cell cycle regulation. In response to DNA damage, the N-terminus (NT) of the human Rpa2 subunit becomes hyper-phosphorylated by several checkpoint kinases. Previously, we demonstrated in the budding yeast Saccharomyces cerevisiae that yeast Rpa2 NT phosphorylation is difficult to detect under genotoxic conditions, yet it is vital for the damage response. To overcome this, we generated chimeric yeast Rpa2 proteins containing the human NT, and previously showed that the chimeric Rpa2 in yeast is hyper-phosphorylated in a manner nearly indistinguishable from that in human cells.

In human cells, phosphorylation of human Rpa2 NT at specific sites is not only damage-dependent, but also interdependent in that phosphorylation of one site depends on previous phosphorylation of other sites within the NT. To examine this in yeast, we generated and utilized individual non-phosphorylatable site mutants. In yeast cells, phosphorylation at one site does not depend on phosphorylation at different phospho-sites within the NT. Furthermore, we have found that different types of damage can affect phosphorylation of the human Rpa2 NT differently in yeast. Identification and characterization of phosphorylation of both the yeast (native) and "humanized' yeast Rpa2 allows us to gain an understanding of conserved properties/functions between the two systems.

Support: This work was supported by award NSF-CAREER-1253723 from the National Science Foundation to SJH.

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COMPARISON OF INTERNAL STANDARDS FOR GC-MS ANALYSIS OF CAFFEINE EXTRACTED FROM HUMAN SALIVA SAMPLES

Belinda Zabka* (U), Brett Nespor, Alex Buccholz, and Naomi Winburn

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In order to analyze caffeine in human saliva samples for use in a study done by the psychology department at MSU, an acceptable method for its extraction and analysis was developed. This method, consisting of a liquid-liquid extraction using ethyl acetate along with centrifugation and subsequent GC-MS analysis was capable of detecting caffeine in artificial saliva samples prepared in the lab. The focus of this particular research was the determination of an internal standard that would effectively improve the limit of quantification for this method. Lidocaine and acetaminophen were investigated, using human saliva samples. A number of internal standard concentrations were investigated along with a number of standard curves. The final method, producing complete peak separation for all human saliva samples analyzed utilized a 25 mg/L concentration of acetaminophen as an internal standard and a standard curve range of 0-50 mg/L.

Support: Financial Support was provided by ND INBRE.

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GRADUATE COMMUNICATIONS

IN THE

A. RODGER DENISON COMPETITION

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

USING CRISPR-CAS9 TO RESCUE MEIOTIC RECOMBINATION IN RECOMBINATION-DEFECTIVE CELLS

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The CRISPR-Cas9 system utilizes a guide RNA to create a double-strand break (DSB) in a specified region of the genome. Guide RNAs contain sequences complementary to the desired target site, and in concert with Cas9, act as a molecular DNA scissors to cleave the double-stranded DNA (dsDNA) at this target site. However, a major deficiency of the CRISPR-Cas9 system is that it has also been reported to have many off-target effects (*i.e.*, it also cuts dsDNA at other non-specific sites).

Spo11 is a protein conserved from yeast to humans that is expressed specifically during meiosis and is responsible for making DSBs that drive meiotic (or homologous) recombination. Since both Cas9 and Spo11 are capable of making DSBs, we created cells in which the wild-type *SPO11* gene was replaced with *Cas9*. In this system, Cas9 should be expressed during meiosis when Spo11 is normally required.

By using Cas9 to make DSBs during meiotic recombination, we will determine if a recombination-less meiosis can be rescued and if yeast might be used as a tool to measure off-target effects. Thus far, we have shown that expression of Cas9 alone (without a guide RNA) does not drive homologous recombination (as expected). Unfortunately, co-expression of Cas9 with guide RNAs tested thus far do not rescue a *SPO11* deficiency. We are currently investigating why rescue does not occur as well as making adjustments to the system that might restore meiotic recombination in a *spo11* mutant.

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

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ENERGY CONSUMPTION OPTIMIZATION FOR 3D PRINTING

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3D Printing (3DP) processes are at the core of next generation manufacturing which focus on accelerating the domestic manufacturing competitiveness and reviving the overall economy. One of the major constraints of 3DP processes is that they consume a significant amount of resources (i.e., time, energy, material, and support structure). Higher throughput may be achieved using better hardware which is also limited under many circumstances. On the other hand, improved 3DP process plan algorithm to expedite the process is quicker and easy to implement. In this work, a hierarchical 3DP process plan framework is developed which minimizes part build time in extrusion based 3DP.

The proposed algorithm determines the optimal build direction of a part through minimizing contour plurality, build height, part geometric complexity, and surface quality. It also yields optimal deposition direction maximizing continuous material deposition path length and consequently minimizing non-deposition time. In order to assess the effectiveness of the proposed framework, a part build time estimation model is developed and evaluated.

The implementation of the proposed methodology on two example parts demonstrate 21% and 8% reduction in their overall estimated build times. Thus, the proposed 3DP process planning framework will result in minimum build time for free-form parts and reduce the total energy consumption during their 3D Printing processes.

Support: No financial support was provided for this work.

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DETERMINING THE ROLE OF PHOSPHATASE ACTIVITY ON RPA2 PHOSPHORYLATION AND CHECKPOINT ARREST

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Broken DNA can be detrimental to the cell if not repaired properly. Fortunately cells monitor the integrity of their genome to ensure the DNA is intact prior to DNA replication (S-phase) and entrance into mitosis (M-phase). If the DNA integrity is compromised, several proteins work in concert to signal the cell to stop its progression through the cell cycle (checkpoint arrest) until the damaged DNA is fixed.

A powerful signaling tool for cells is phosphorylation of proteins. In Saccharomyces cerevisiae, phosphorylation of Rad53 activates its kinase activity to trigger checkpoint arrest. Until the DNA is repaired, Rad53 remains phosphorylated, and the cell remains arrested. Once repaired, Rad53 must be dephosphorylated in order for the cell to exit the checkpoint arrest. One phosphatase responsible for the dephosphorylation of Rad53 is the protein phosphatase 4 (PP4) complex. The complex has at least two subunits encoded by the genes PPH3 and PSY2 in yeast.

To study the role of each of the subunits of the PP4 complex in checkpoint arrest, knockouts (KOs) of PPH3 and PSY2 were created by replacement with a selectable marker encoding for nourseothricin resistance. The pph3 or psy2 KO cells were then subjected to DNA damaging agents and total protein was extracted from the cells. This protein is currently being used to biochemically characterize the effects on yeast Rpa2 phosphorylation, which has been demonstrated to play a role in both the entry and exit of checkpoint arrest.

Support: This work was supported by NSF-CAREER-1253723 from the National Science Foundation to SJH.

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THE ROLE OF CCCTC BINDING FACTOR (CTCF) IN EPITHELIAL TO MESENCHYMAL TRANSITION (EMT)

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The process of Epithelial to Mesenchymal transition (EMT), plays a major role in cancer metastasis and drug resistance. Signaling pathways such as TGF-β, EGF and hypoxia can trigger EMT through upregulation of the Snail master regulator protein. However, the underlying cause for what triggers Snail activation during EMT remains unknown. We used a bioinformatics mining approach to detect transcription factor binding sites upstream of the SNAIL gene, and identified putative sites for CTCF, a transcription factor important in regulation of chromatin 3D structure and genome reorganization. Recently, it was shown that CTCF recruits Smad proteins to their gene targets following addition of TGF-β in Drosophila cells. The EMT master regulatory protein SNAIL is among the key targets of Smad proteins. Therefore, we hypothesized that CTCF plays a role in TGF-β induced EMT both at the transcriptional level, and at the genome architectural level, leading to increased metastasis.To test our hypothesis, we induced EMT in the non-cancerous murine mammary gland cell line (NMuMG), followed by Chromatin immunoprecipitation (ChIP) to determine Ctcf enrichment at the Snail promoter. Our preliminary data revealed TGF-β dependent enrichment of CTCF at the promoters and upstream regions of Snail, relative to the control-treated cells.This enrichment of Ctcf at the Snail gene corresponded to the TGF-β dependent expression of Snail mRNA, suggesting a role for Ctcf in regulation of the Snail gene.

Support: This work was supported by award 5P20GM104360 from the National Institutes of Health to AD.

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DETECTION OF NON-O157:H7 SHIGA TOXIN-PRODUCING *ESCHERICHIA COLI* USING IMMUNOMAGNETIC SEPARATION

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An emerging concern in public health and food safety in the United States involves the need to accurately detect six serogroups of Shiga toxin-producing *Escherichia coli* (STEC), which include O26, O45, O103, O111, O121, and O145. Since these adulterants thrive in the GI tract of cattle, it is crucial to use reliable detection methods that will work in matrices like cattle feces, as well as in ground beef and produce, which can be exposed to these pathogens by fecal contamination. Immunomagnetic separation (IMS) has been a useful technique in the detection of pathogens. However, an assessment has not been performed on the extent that matrices or commensal microbes influence recovery of each serotype by IMS. For evaluation of IMS, samples of PBS, sterile and non-sterile cattle feces, ground beef, and lettuce were innoculated with a mixture of six representative strains. Innoculated samples were mixed with IMS beads, a portion of that sample was plated on EMB, and three suspect *E. coli* colonies were selected for a multiplex PCR to confirm serogroup. In PBS, 100% correct identification of serotypes occurred for the majority of IMS bead types. With the addition of more complex matrices and competing microbes, ground beef and lettuce had the lowest recovery, in some cases with 0% correct identification. These results suggest that there is a marked influence on IMS detection of these pathogens in complex matrices with competing microbes.

Support: This work was supported by USDA ARS 5442-32000-013-035.

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AUTISM-LINKED MUTATIONS IN THE HUMAN SEROTONIN TRANSPORTER INDUCE DISTINCT STRUCTURAL CHANGES

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Background: Physiological studies show that 20-25% of individuals with autism spectrum disorder (ASD) exhibit elevated platelet serotonin (5-HT) levels suggesting a link between regulation of the serotonergic system and ASD. Furthermore, multiple ASD-linked serotonin transporter (SERT) coding variants (ASVs) have been identified which augment 5-HT transport function through enhanced catalytic activity (G56A and K605N) or elevated surface density (I425L, F465L, and L550V).

Objective: Identify SERT tertiary structure alterations mediated by ASV modifications.

Results: We utilized the substituted cysteine accessibility method to assess conformational changes by comparing the sensitivity of one native (C109) and one engineered cysteine residue (C277) to methanethiosulfonate reagents (MTS). C109 exhibited increased reactivity in the ASVs G56A, I425L, F465L, and K605N indicating enhanced accessibility as a result of ASV-induced conformational changes. Conversely, C277 displayed decreased reactivity in the ASVs G56A, I425L, L550V, and K605N demonstrating reduced accessibility as a result of conformational changes.

Conclusion: The reactivity changes we have observed at C109 and C277 support alteration of SERT tertiary structure by each ASV. In addition, the extracellular position of C109 and the intracellular position of C277 in SERT with a respective increase and decrease in MTS sensitivity suggests that mutants G56A, I425L, and K605N induce an outward-facing conformation.

Support: No financial support was provided for this work.

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LONG-DISTANCE REPRESSION AS A POTENTIAL MECHANISM OF CROSS-LINEAGE ANTAGONISM IN HEMATOPOIESIS

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During hematopoiesis, cell type is specified by gene regulatory networks (GRNs). The structure of these networks remains to be fully understood. One main organizing principle termed cross-lineage antagonism, is that transcription factors (TFs) expressed in alternative lineages repress each others' expression. We are investigating whether silencers are utilized to effect cross-lineage antagonism. Determining the function of cis-regulatory modules (CRMs) is a challenging task because they can be regulated by multiple interacting TFs. To overcome the challenge posed by complex regulation, we utilize a computational model that explicitly simulates TF-TF interactions by utilizing multiple datasets, such as DNA sequences, estimates of TF concentrations, TF binding properties, and CRM activity, to infer the TFs regulating CRMs. A previous application of this methodology predicted nine silencers within the Cebpa locus. One putative silencer, lying 15kb downstream of the Cebpa transcription start site is predicted to be repressed by GATA2 and EBF1, TFs expressed in the erythroid-megakaryocytic and lymphoid lineages respectively. We experimentally tested whether this silencer mediates the repression of Cebpa by TF expressed in alternative lineages. Elucidating the silencer-driven mechanisms of cross-lineage antagonism will help us understand the structure of GRNs involved in lineage specification and pave the way for predictively modeling this important developmental phenomenon.

Support: University of North Dakota Department of Biology and ND EPSCoR.

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THEORETICAL CALCULATION OF THE ULTRAVIOLET ABSORPTION OF PROPARGYL RADICAL AROUND 242 NM

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The propargyl radical, the most stable isomer of C_3H_3, is very important in combustion reactions, and a number of spectroscopic and dynamics studies have been performed over the years to study its reactivity. However, theoretical calculations have never been able to find a strong absorption around 242 nm as seen in experiments. In this study, we calculated the electronic energy levels of the propargyl radical using the highly accurate multireference methods including multireference configuration interaction singles and doubles method with triples and quadruples treated perturbatively [denoted as MRCISD(TQ)], second and third order generalized Van Vleck perturbation theories (GVVPT2 and GVVPT3). Calculations indicate that this absorption can be solely attributed to a Franck–Condon-allowed transition from the ground B_1 state to the Rydberg-like first A_1 excited state. Calculations also show that GVVPT2 fails capture enough Rydberg character of this excited state, while it can be recovered by GVVPT3 and MRCISD(TQ).

Support: This work was supported by NSF IIA-1355466 and ND EPSCoR.

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ASSOCIATION BETWEEN PROTEIN COMPOSITION AND QUALITY CHARACTERISTICS IN HISTORICAL AND MODERN WHEAT

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The hard red spring (HRS) wheat cultivars released in North Dakota during the last 100 years have shown improvements in characteristics, such as adaptation to growing conditions, yield, and quality traits. The objectives of this study were to identify the changes in quality characteristics that occurred over time, and to determine the association of these characteristics with protein components in historical and modern HRS wheat. For this purpose, 30 HRS wheat cultivars released between 1910 and 2013 were analyzed for correlations between quality traits and release year, and also between quality traits and protein composition. A highly significant positive correlation ($P \leq 0.01$) was found between release year and farinograph parameters, such as peak time and stability. Results from size-exclusion-HPLC showed significant positive correlations ($P \leq 0.01$) between year of release and glutenin polymeric proteins and the ω-gliadin fraction, which also had significant positive ($P \leq 0.01$) correlations with dough characteristics. Reverse-phase-HPLC was used to confirm the above findings for ω-gliadin proteins, where some peaks corresponding to these proteins showed significant positive correlations ($P \leq 0.05$) with year and dough properties. In conclusion, the quantitative increase in glutenin polymeric proteins, and certain sub-fractions of ω-gliadins could be associated with the favorable dough properties that are seen in modern HRS wheat cultivars.

Support: This work was supported by grants from the North Dakota Wheat Commission and the U.S. Wheat Associates to SS.

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ADSORPTION OF WATER ON ULTRATHIN SILICA FILMS

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Ultrathin silica films were synthesized at ultra-high vacuum conditions (UHV) by vapor depositing silicon onto an oxidized Mo(112) substrate. Low energy electron diffraction (LEED), Auger electron spectroscopy (AES), and X-ray photoelectron spectroscopy (XPS) were utilized as characterization tools. Water adsorption on synthesized silicatene films was investigated at UHV using thermal desorption spectroscopy (TDS). According to TDS results, crystalline silicatene films synthesized on Mo (112) are hydrophobic. The preparation procedure can affect the wetting properties. Therefore, water-TDS is a sensitive tool which can be used to distinguish between well-ordered and defected silicatene films, respectively.

Support: ACS PRF 54179-ND5.

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DETECTION OF TORQUE TENO SUS VIRUS 1 (TTSUV1) DNA AND ANTIBODIES IN OTHER DOMESTIC ANIMALS AND ELK

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TTSuV1 of family Anelloviridae, has negative sense, single-stranded, circular DNA genomes and is distributed globally in swine population. As TTSuV found in both diseased and healthy domestic pigs, it's role in causing specific swine disease is still unclear. Experimental studies in gnotobiotic pigs indicated that TTSuV1 can be a primary or co-infecting pathogen in clinical syndromes such as the porcine dermatitis and nephropathy syndrome and post-weaning multi-systemic wasting syndrome. However, it is not known whether cross-species transmission of TTV's occur. In this study by using TTSuV-1 - specific ELISA and a panel of TTSuV1-specific PCRs targeting the conserved untranslated regions or more variable open reading frames, the combined serological and molecular epidemiological profile of TTSuV1 infection in five different species (equine, canine, bovine, ovine and elk) was determined using sera samples from the target species. Significant levels of antibody responses to TTSuV1 were detected bovine, ovine and equine samples as compare to canine and elk. TTSuV1 DNA was detected in 46.7% of equines, 70% of canine, 100% of bovine, 40% of ovine and 93.3% of elk by the real-time targeting the UTR region. Detection by PCR's targeting the ORF's was variable. The data from this study provides preliminary evidence that TTSuV1 could infect other species. However, further studies are required to demonstrate the health risk to these animal species from TTSuV-1 infection.

Support: This project was funded by NIH P30 GM103332 from the National Institute of General Medicine (NIGMS) and the NDSU Advance Forward Program (NSF HRD-0811239). Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the NIH or NSF.

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KINETICS AND DYNAMICS OF N-BUTANE ADSORPTION ON RU(0001) AND GRAPHENE/RU(0001)

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This study focused on measuring adsorption probabilities of n-butane adsorption on both Ru(0001) and graphene physical vapor deposited on Ru(0001). The temperature and kinetic energy dependent adsorption probabilities were studied individually on these two samples. The adsorption probabilities decreased with increasing kinetic energy of the alkane, consistent with molecular adsorption and in agreement with Auger and X-ray photoelectron spectroscopy data also collected. The adsorption probabilities were similar for both Ru(0001) and graphene/Ru(0001). In addition, kinetics parameters were determined using thermal desorption spectroscopy. The coverage dependent binding energies did not show a significant difference between n-butane adsorption on Ru(0001) and graphene/Ru(0001). Overall, our study clearly indicated that graphene on Ru(0001) is a transparent material: coverage dependent binding energies and adsorption probabilities for Ru(0001) and graphene/Ru(0001) mimicked each other. The results are similar to benzene adsorption studied earlier [Journal of Vacuum Science & Technology A 34, 021402 (2016)].

Support: None listed.

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ULTRASENSITIVE LATERAL FLOW NUCLEIC ACID BIOSENSORS BASED ON NOVEL MACRO-/NANO-MATERIALS

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In the field of molecular diagnostics, there exists a need for development of sensitive and selective detection strategies for the disease related nucleic acid biomarkers. Lateral flow biosensors (LFBs), as a promising tool for detecting analyte, have recently attracted considerable interest because of their speed, simplicity, sensitivity, specificity, easy handling, and can potentially provide instantaneous diagnosis near the patients. We present a rapid and highly sensitive approach for visual detection of microRNA (miRNA) using gold nanoparticles (GNP) coated silica nanorod (SiNR) label and lateral flow strip biosensor (LFSB). After systematic optimization, the new LFSB was capable of detecting 10 pM of the miRNA target without instrumentation, which is 6 times lower than that obtained with the GNP-based LFSB. The GNPs-SiNR thus provides a new and sensitive nanolabel for visual detection of biological molecules on the lateral flow biosensors.

Support: This work was supported by NIH-R21CA137703 to GL.

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SUNLIGHT HARVEST: SEMI-FLEXIBLE POLYESTER SYNTHESIZED FROM BIO-BASED FURFURAL IN SUNLIGHT

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Due to the limitation of fossil resources and growing demand of polyester market, to synthesize polyesters from sustainable resources has been a common goal of academic and industrial researchers. The synthesis of linear polyester was started from bio-based furfural. Furfural was first converted to 2-furanacrylic acid as a key photoreactive building block for the synthesis of the monomer. Monomer was then prepared by linking two 2-furanacrylic acid molecules with a bifunctional 1,5-pentanediol, which can also be produced from furfural. An important photoreactive crystalline assembly of the monomer was characterized by powder and single crystal X-ray diffraction. The new linear polyester that contains 100% components from biomass-derived chemicals was synthesized by sunlight photoreaction of the pre-organized monomer in the solid state in 12 hours. The solvent-free sunlight photoreaction process was monitored by FT-IR and a key intermediate was confirmed by single crystal X-ray diffraction. Nanofiber of the linear polyester was observed under TEM.

Support: NSF EPSCoR Award IIA-1355466.

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A NOVEL ROLE FOR RPA PHOSPHORYLATION IN THE FACE OF PERSISTENT DNA DAMAGE

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Replication Protein A (RPA) is a heterotrimeric, single-stranded DNA binding complex with critical roles in DNA metabolism and cell cycle progression. RPA is observed to be hyper-phosphorylated in response to genotoxic stress, primarily on the N-terminus (NT) of the 32 kDa subunit (Rpa2). Examination of Rpa2 NT phospho-mutants suggests that the phospho-state of this domain may play a key role in promoting cell cycle progression, even in the presence of damaged DNA (checkpoint adaptation). Although checkpoint adaptation provides the cell the chance to survive, it comes with the consequence of increased genomic instability that can ultimately lead to cellular disease.

Using budding yeast, we have demonstrated that in the presence of persistent DNA damage, Rpa2 NT hyper-phosphorylation is readily detected. Furthermore, the Rpa2 NT is necessary for checkpoint adaptation. We have determined which kinases phosphorylate the Rpa2 NT during checkpoint adaptation and have evidence suggesting that phosphorylation occurs primarily upon prolonged exposure to genotoxic agents that cause DNA double-strand breaks (DSBs). We propose a model suggesting that Rad53 deactivation (necessary for checkpoint bypass) and Rpa2 NT phosphorylation may be linked to coordinate checkpoint adaptation in yeast. Understanding how RPA phospho-states influence cellular division in the presence of genotoxic stress will assist in deciphering the molecular mechanisms cells employ to maintain their genome.

Support: This work is supported by award NSF-CAREER-1253723 from the National Science Foundation to SJH.

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PATH PLANNING ALGORITHM FOR AUTOMATED HARVEST IN IRREGULAR CROPPED AREA

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Automated Harvest worked well in improving the efficiency and saving labor cost in the past decades. An automated machines needs a planned path to direct the operation. This paper introduces an algorithm for path planning in irregular cropped area to further improve the efficiency. A nonlinear optimization model is presented to determine the path plan with shortest travel distance. The model considers both field boundary and the inner non-cropped area when determine constraints. The travel speed of the harvester is considered to be constant in this model. And an example will be given in this paper to apply this model and finding the optimal path for automated harvest.

Support: No financial support was provided for this project.

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INFORMATION ASYMMETRY IN BUDGET ALLOCATION: ANALYSIS OF THE TRUTH-INDUCING INCENTIVE SCHEME

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In budget allocation, Information asymmetry occurs when the project managers have better information regarding the project costs than the portfolio manager. Information asymmetry between the project managers and the portfolio manager creates an opportunity for the project managers to negotiate for budgetary slack to improve their performance when their compensation is associated with budget attainment, resulting in a false evaluation of managers' budget needs. One way to avoid the problems caused by information asymmetry is the use of a truth-inducing incentive scheme. The truth-inducing incentive scheme is one tool to reduce budgetary slack caused by information asymmetry between the project managers and the portfolio manager. We identify the value of penalty coefficients in the truth-inducing incentive scheme when information asymmetry is present. We first describe the allocation method that achieves budget optimization by assuming that the uncertain costs follow a normal distribution and determine the allocated budget depends on the mean and the standard deviation of the uncertain cost of the project. Then we demonstrate the process of identifying the penalty coefficients based on the judgments of the portfolio managers and the project manager regarding the budget optimization. We report an upper bound on the ratio between the key coefficients in the truth-inducing incentive scheme. We conclude that when the portfolio budget is tight, the penalty coefficients for being ...

Support: No financial support was provided to YZ, JGS or YY.

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PROFESSIONAL COMMUNICATIONS

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

EXPRESSION OF ESTROGEN RECEPTORS IN SHEEP PLACENTA DURING EARLY PREGNANCY

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Steroids mediate uteroplacental vascular development and remodeling in early pregnancy which is critical for embryonic growth. We hypothesized that expression of estrogen receptor proteins (ESR alpha and beta) will change during utero-placental development as early pregnancy progresses and after application of assisted reproduction technology (ART).

In Exp. 1, uterine tissues were collected on days 14 to 30 after mating and on day 10 after estrus (n = 4;). In Exp. 2, uterine tissues were collected on Day 22 after natural mating (NAT) or after embryo transfer (NAT-ET), in vitro fertilization (IVF), or in vitro activation (IVA) (n= 3-5/treatment group). Expression of ESR in uteroplacental tissues was determined using immunofluorescence.

ESR alpha and beta were present in fetal membranes, ESR alpha in luminal epithelium (LE), endometrial glands (EG) and myometrium (Myo), and beta in EG, endometrial blood vessels (EBV) in both experiments. In Exp. 1, greater expression of ESR alpha in LE and EG was observed in non-pregnant than pregnant ewes. In Exp 2, ESR alpha was expressed in LE, EG and Myo in NAT but not detected in NAT-ET, IVF and IVA groups; and ESR beta was expressed in EG and EBV of NAT and NAT- ET but was not detected in IVF and IVA.

Our data demonstrate a differential localization pattern of ESR alpha and beta protein in uteroplacental compartments during early pregnancy and after ART indicating a specific function depending on reproductive stage.

Support: NIH grant 1R03HD076073-02 to LPR and ATGB.

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PRE-ECLAMPSIA AND RISK OF SUBSEQUENT HYPERTENSION: IN AN AMERICAN INDIAN POPULATION

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Background and Objectives: Preeclampsia (PE) is a pregnancy-specific disorder of unknown etiology. A number of proposed pathophysiologic mechanisms relate to similar factors implicated in cardiovascular disease. Pre-eclampsia has been associated with subsequent hypertension, cardiovascular disease and related mortality in later life.

Methods: Recent blood pressures, body mass index (BMI) and use of hypertensive medications were recorded from clinic visits of 130 PE cases and 289 normal pregnancies. Student's t test, chi-square testing, multivariate linear and logistic regression were used in analysis.

Results: Results: Follow-up measurements occurred a mean of 13.11 years (range 3.6 to 36.7 years) post PE pregnancy. Multivariate linear regression showed significant and independent association between BMI (SBP β=0.47, DBP β=0.29), age (SBP β=0.19, DBP β=0.14), previous history of PE (SBP β=4.47, DBP β=2.71) and current systolic and diastolic blood pressure (all p values <0.002). Analysis of the quartile with follow-up of less than 7.19 years also shows independent association of prior PE with subsequent hypertension. Multivariate logistic regression analysis found an odds ratio of 3.71, 95% CI 2.04 - 6.72, p=0.001 for subsequent hypertension.

Discussion and Conclusions: PE appears to confer risk of subsequent hypertension on American Indian women after a period of about 7 years. This risk is independent of additional risk factors such as increased BMI and age.

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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A ROLE FOR THE SNAIL TRANSCRIPTION FACTOR IN ALTERNATIVE SPLICING DURING EMT

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During cancer metastasis, the epithelial to mesenchymal transition (EMT) involves molecular changes in epithelial cells, resulting in acquisition of a mesenchymal, migratory phenotype and drug resistance. EMT is regulated in part by the transcription factor SNAIL, which interacts with proteins to control gene expression. We used mass spectrometry to identify novel SNAIL-interacting proteins that potentially contribute to EMT. The most significant proteins that co-immunoprecipitated with SNAIL were identified as splicing factors. Splicing is an important biological process that joins exons together while removing introns, resulting in mature mRNA. Alternative splicing mechanisms generate proteome diversity by joining different combinations of exons together. Therefore, we hypothesized that SNAIL interaction with the spliceosome during EMT causes dysregulation of alternative splicing and faulty isoform expression. To test this hypothesis, we induced EMT with transforming growth factor beta (TGFβ) in the human mammary gland cell line MCF10A, resulted in isoform switching of mRNAs. Simultaneously, we observed that the splicing factor SRSF1 co-immunoprecipitated and co-localized with SNAIL following TGF-β induction. Knockdown of SNAIL with siRNA prevents this isoform switch, indicating the involvement of SNAIL in alternative splicing, either directly or indirectly. Taken together, our data support a novel role for a transcription factor in alternative splicing.

Support: This work was supported by award 5P20GM104360 from the National Institutes of Health to AD, and award NSF-CAREER-1253723 from the National Science Foundation to SJH.

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REQUIEM FOR (HISTORIC) REFERENCES: BEYOND THE TRADITIONAL DOCUMENTATON OF PALEO PUBLICATIONS

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The Web has made access to older (historic) literature readily available. Meek and Hayden (1857) is a typical example. It introduces new marine and continental molluscan species and places all taxa into a numbered stratigraphic framework. Of importance to them was the timely publication of their observations in bio- and geohistory. Competition was strong for bragging rights over the interpretation of the chronostratigraphy of the western territories. Meek and Hayden made special note of the comparative accuracy of their resulting from their research methods. Thus our understanding of past events is based not only on the timing of their field observations, but on the availability of their results to the natural science community. Example.-Meek, F.B., and Hayden, F.V., 1857 [after Apr. 25] {1856}, Descriptions of new fossil species of Mollusca collected by Dr. F.V. Hayden, in Nebraska Territory; together with a complete catalogue of Invertebrata hitherto described and identified from the Cretaceous and Tertiary formations of that region: Academy of Natural Sciences of Philadelphia, Proceedings, v. 8, p. 265–286. Although frequently cited in compilation works (e.g., Nickles, 1923) as Meek and Hayden (1856), the signature of the paper was not available in print until April 25, 1857 (Nolan et al., 1913). Thus all 20 new species and nomenclatural revisions described by Meek and Hayden must be referenced to this date. Their paper was presented to the Academy on November 11, 1856, and was reported from committee for publication on November 25. Thus six months passed from presentation to publication. As young researchers, the communication of rapidly developing research, often being sent from the field (e.g., St. Louis) was imperative to carve out their research niche in the West.

Support: None.

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APPLICATION OF MIXTURE QSPR/QSAR APPROACH FOR STUDIES OF ANTIFOULING/FOULING-RELEASE COATINGS

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Polysiloxane coatings containing tethered quaternary ammonium salt (QAS) moieties, were reported to be environmental-friendly coatings to control marine biofouling. Experimental data were collected for 4 different properties of 24 compositions for PDMS-18K compositions of the coatings. For the purpose to develop better coating materials with highest anti-fouling and fouling-release properties we decided to adopt a Quantitative Structure-Activity/Property Relationship (QS/PAR) approach. QSPR/QSAR for mixtures approach was applied, keeping in view the presence of multiple components in one coating system and also complex nature of the coating systems. The applied descriptors were calculated for the individual components of the each coating system and then utilized to calculate mixture descriptors for the coating systems. QSAR/QSPR models were generated for each of the 4 endpoints (properties and bioactivities) of the coating systems.

These models were validated through internal cross validation and external validation. All the developed QSAR/QSPR models showed robust predictive ability. The developed QSAR/QSPR models showed a good predictive ability for all 4 endpoints for 18000g/mol coating systems. Since all the developed models fulfilled the criteria of validation therefore developed models can be used for the prediction of Surface energies, CAH, Biofilm reduction (C. Lytica) and Biofilm growth retention (N, Insertia) for novel coating compositions.

Support: This work was supported by US Department of Energy through Grant No. DE-SC0001717 are gratefully acknowledged.

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ARE GIBBERELLINS INVOLVED IN CONTROL OF LIGHT-DEPENDENT LEAF EXPANSION IN ARABIDOPSIS

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Plant development is controlled by light. In particular, the expansion of leaf cells, which accounts for upwards of ninety percent of final leaf area, is light dependent. The mechanism of light-dependent leaf expansion is poorly understood. Gibberellins (tetracyclic diterpenoids) are a class of plant hormones known to be important controllers of seed germination, stem elongation, and floral development. Gibberellin-deficient mutants of the model plant Arabidopsis, however, also have unexpanded leaves when grown in light.

We hypothesize that light-induced leaf expansion in mediated through elevated leaf gibberellin levels. Our model system is the first and second true leaves of soil-grown Arabidopsis thaliana. These leaves expand simultaneously allowing all experiments to use one leaf of each plant as a control for treatments of the opposite leaf eliminating between plant variance in the analysis of the results.

After 24 hours detached on media leaf area increase 96.3 +/- 7.2 (SE) % in white light (130 μM m-2 • s-1) while only 38.1+/- 2.0 % in darkness. Gibberellic acid (GA3) was found to increase leaf expansion at concentrations from 30 μM to at least as low as 0.1 μM in both light and dark. These results are consistent with gibberellins having a role in light-induced leaf expansion. Planned experiments include determination of the endogenous gibberellin content of light and dark grown leaves and testing the effects of the gibberellin synthesis inhibitor paclobutrazol.

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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PALMITATE-INDUCED ER STRESS ABROGATES IGF1 EXPRESSION IN THE BRAIN: IMPLICATIONS IN AZHEIMER DISEASE

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Evidence shows that the insulin-like growth factor-1 (IGF1) reduces β-amyloid (Aβ) production and tau phosphorylation, the two major hallmarks of Alzheimer's disease (AD). Several studies have shown that serum levels of IGF1 are decreased in AD patients and there is compelling evidence that IGF1 is involved in the metabolism and clearance of Aβ from the brain. IGF-1 expression is regulated by the transcription factor C/EBPα. Contemporary research suggests a positive correlation between consumption of a diet rich in saturated fatty acids, such as palmitic acid and the risk of developing AD. A plethora of studies have shown that saturated free fatty acids (FFA), such as palmitic acid, evoke ER stress. However, the extent to which palmitic acid (palmitate) – induced ER stress is involved in the attenuation of IGF1 expression has not been determined. In this study, we demonstrate that palmitic acid-induced ER stress mitigates IGF1 expression by inducing the expression of the C/EBP Homologous Protein (CHOP) protein, which negatively regulates C/EBPα, a transcription factor required for IGF1 expression. The molecular chaperone 4-phenylbutyric acid (4-PBA) precludes the palmitic acid-evoked ER stress and down-regulation of IGF1 expression. Knocking-down CHOP expression alleviates the mitigation in expression of IGF1. ER stress as the mechanistic link in the palmitic acid-induced negative regulation of IGF1, a cytokine that has therapeutic potential to thwart the progression of AD.

Support: This work was supported by a Grant from the NIH (R01AG0145264) to Othman Ghribi.

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SPONTANEOUS MUTATIONS IN THE FLHD OPERON GENERATE MOTILITY HETEROGENEITY IN ESCHERICHIA COLI BIOFILM

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Heterogeneity and niche adaptation in bacterial biofilm involve changes to the genetic makeup of the bacteria and to gene expression control. We hypothesized that IS element insertion into the flhD operon, which expresses the flagellar master regulator, may generate motility heterogeneity in Escherichia coli K-12 biofilms, alongside other possible mechanism to mutate this operon.

We allowed the highly motile E. coli K-12 strain MC1000 to form seven- and fourteen-day old biofilms, from which we recovered reduced motility isolates at a substantially greater frequency (5.4%) than from a similar experiment with planktonic bacteria (0.1%). From biofilms formed by the less motile AJW678, we recovered hyper-motile isolates. Biofilms formed exclusively by the highly motile MC1000 degraded after 2 weeks. In contrast, biofilms initiated with a 1:1 ratio of MC1000 and its isogenic flhD::kn mutant remained intact at 4 weeks and the two strains remained in equilibrium for at least two weeks. These data indicate that an 'optimal' biofilm may contain a mixture of motile and non-motile bacteria.

Twenty-seven of the non-motile MC1000 isolates contained an IS1 element in close proximity to the translational start of FlhD or within the open reading frames for FlhD or FlhC, locations that are consistent with the lack of motility. In contrast, two of the hyper-motile AJW678 isolates contained an IS1 element about 200 bp upstream of the transcriptional start of FlhD. We believe that the insert…

Support: None listed.

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CHEMINFORMATICS METHODS IN POLYMER COATING MATERIALS STUDY: MIXTURE-QSAR TO PREDICT FOULING RELEASE

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Polymer coating materials have widespread application due to their versatile characteristics, cost-effectiveness, and highly tailored production. Thus, surface interactions of polymer substrates are an essential area of study in biotechnology, nanotechnology, and in all forms of coating applications. In these cases, the surface characteristics of the polymer material largely determine its utility and reliability. The application of polymer coating materials in reducing of biofouling of ship hulls is very important, since biofouling is an ongoing issue that has major economic and environmental impact.

In this work, we have investigated a set of polymer coating materials for antifouling and fouling-release activity. Specifically, a set of 27 polymer coating materials was generated by using a combinatorial, high-throughput approach and characterized for activity towards a number of relevant marine fouling organisms, including bacteria, microalgae and adult barnacles. In order to model these complex systems, all investigated coating materials were considered as mixture systems, having particular components in various concentrations. A set of molecular descriptors was generated to encode components. Based on applied quantitative structure-activity relationship for mixtures (mixture-QSAR) approach several predictive models were developed. All models were tested on an external validation set to confirm the robustness. The contribution of certain structural properties to biofouling release activity.

Support: The research has been financially supported by the U.S. Department of Energy through Grant No. DE-SC0001717

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PHYLOGENY OF BUXINEAE: BOXWOODS AND RELATED

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Within flowering plants, boxwood family and several satellite groups form a distinct taxon (suborder Buxineae) diverged from the base of angiosperm phylogenetic tree in the lower Cretaceous. Six genera comprise about 138 species, mainly associated with Tropical America, East and South Africa and Madagascar, and East Asia. The largest are well-known tree-like or shrubby boxwoods, Buxus. Sarcococca and Pachysandra are small genera of low shrubs or even rhizomatous herbs. Few species of woody Styloceras grow in South America. Two last genera are more distinct: Didymeles with three species, all from Madagascar, and monotypic Haptanthus from Honduras.

Data from rbcL and ITS2 were integrated in the phylogeny tree thus represented both nuclear and chloroplast genomes. This tree allows to establish the comprehensive classification of the Buxineae, trace the times of diversification and biogeographic relationships between subgroups.

Support: This work was supported by ND INBRE, the Department of Biology of Minot State University, and through collaboration with the Barcoding of Life Project and the curators of herbaria (US, NY, HUH, MO, CAS, UC, JEPS, F and B) who provided us with specimens.

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POSTER COMMUNICATIONS

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

ARABINOXYLANS FROM CEREAL PROCESSING BYPRODUCTS AS A BASIS FOR BIODEGRADABLE FOOD PACKAGING

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Arabinoxylans are non-starch polysaccharides in the cell-walls of cereal crops. Two of the most commonly grown cereal crops are corn and wheat. Both corn and wheat are highly processed and used for a variety of products from food to feed to fuel. In the processing of these crops, there are large quantities of byproducts produced including wheat bran, corn bran, and dried distillers grains. Wheat bran is produced when wheat is milled into flour. Corn bran is produced from both wet and dry milling corn. Dried distillers grains are the byproduct of the fermentation and distillation process that take place during the production of ethanol for fuel. When food packaging material is made from the wheat bran, corn bran, and dried distillers grains arabinoxylan and glycerol or sorbitol, it has very desirable mechanical properties. Tensile strengths as high as 32 MPa and puncture resistances as high as 10 N can be obtained from this packaging material. The water solubility of the material can be manipulated by changing the amount of plasticizer present to range from 30% to 94%. The water vapor permeability can also range from 61 to 96 g/h*m2. These qualities all show great promise in the area of food packaging for a variety of foods. Once it is possible to package foods in this type of biodegradable food packaging on a commercial scale, the food industry will greatly increase its sustainability.

Support: No financial support was provided for this work.

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ESTIMATING UNDERSTORY BIOMASS, RESPONSE TO FIRE AND GRAZING IN OAK SAVANNA USING TERRESTRIAL LASER S

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Encroachment of woody plants into savanna understory changes vertical structure of biomass, reduces herbaceous vegetation and alters savanna fuelbeds. Oak savanna occurs globally and is characterized by old-growth oak (Quercus spp.) stands and herbaceous understory. Previous land-use and management can allow woody vegetation to dominate the understory and degrade these dynamic ecosystems making control a primary objective of fire and grazing management. Conventional woody biomass sampling is destructive, laborious and time consuming while terrestrial laser scanning (TLS) has the potential to non-destructively sample greater areas efficiently and with fine resolution. TLS was used to model both understory biomass and vertical structure, calibrating TLS against harvested biomass data across a gradient of hazel abundance at the Sherburne National Wildlife Refuge in central Minnesota. The relationship between TLS and harvested biomass was positive which indicates the relative effectiveness and merits of TLS as a non-destructive estimator of woody biomass and understory structure. Additionally, TLS was used to estimate understory biomass and model vertical structure across four treatments: fire, grazing, fire and grazing together and unburned and ungrazed (control). Results indicate that changes in vertical structure rather than understory density may be more suitable for monitoring treatment effects in encroached oak savanna.

Support: No support listed.

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WHOLE-CELL SELEX SCREENING OF APTAMER FOR HUMAN PAPILLOMAVIRUS TRANSFORMED CERVICAL CANCER CELLS

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Cervical cancer is one of the leading causes of cancer related deaths in women. The high mortality rate of cervical cancer is largely associated with late diagnosis. There is the need to develop potent biorecognition elements to aid future biosensor develop and therapeutic studies. Most cervical cancer cases are associated with Human papilloma virus (HPV) infections. We report the selection of aptamers against HPV 16 transformed cancer cells by Systematic Evolution of Ligands by Exponential Enrichment (SELEX). After 21 rounds of selection the best aptamer candidate had a dissociation constant of 92nM. This can be used in future work for the development of diagnostic assays to aid in early diagnosis HPV associated Cervical Cancer.

Support: National Institute of Health.

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THE EFFECTS OF GRASSLAND MANAGEMENT ON POLLINATORS AND THEIR PROVISION OF ECOSYSTEM SERVICES

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Human-driven global change is threatening ecosystems and their provision of services to society. To sustain ecosystem services, conserving biodiversity and ecosystem stability need to be prioritized. A better understanding of management's influence on ecosystems is needed to develop strategies for accomplishing this. We examined the relationship between management and ecosystem services in grasslands by studying the effects of grazing practices on pollinator communities in North Dakota. We observed 727 butterflies of 25 species and recorded 442 bee-flower interactions between 34 bee species and 33 flower species in 2015. Bee and butterfly diversity and abundance were similar across all grazing management practices. Butterfly species density estimates were variable by practice but more data is needed to refine these distinctions. We ran analyses on the plant-pollinator networks to evaluate ecosystem stability, these did not differ by practice at this time. We attribute our initial results to the lack of contrast in vegetation structure and composition among practices driven by a wet spring, and the first of three years of management implementation. We hypothesize that contrast between grazing management practices will increase over time and have a greater influence on pollinator communities. Future results will be useful in guiding grassland management that promotes pollinator populations and their contribution to stable ecosystems that provide multiple services to society.

Support: This project was supported by the North Dakota State University Agricultural Experiment Station.

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TESTING THE INTERACTION BETWEEN SNAIL AND SRSF1 USING THE YEAST TWO-HYBRID INTERACTION SYSTEM

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The *SNAI1* gene encodes for a transcriptional factor (repressor) important in embryonic development and implicated in epithelial-to-mesenchymal transition (EMT), which occurs during cancer metastasis. Using a screen for proteins that interact with SNAIL protein, a number of alternative splicing factors were identified. We are particularly interested in examining the SNAIL interaction with the alternative splicing factor SRSF1.

To examine protein interactions, many systems, both in vitro and in vivo, can be utilized. We are utilizing a system called the yeast two-hybrid system. In this system, one candidate (SNAIL) is fused to a canonical DNA binding domain (DBD) that tethers the protein upstream of a reporter gene. The other candidate (SRSF1) is fused to a transcriptional activation domain (TAD) that cannot activate expression of the reporter gene, unless it is brought into close proximity. If two candidate proteins (SNAIL-SRSF1) interact, the TAD is now also tethered to the DNA upstream of the reporter gene through the interaction with the DBD-tagged protein, resulting in the expression of a reporter gene. We are testing the SNAIL-SRSF1 interaction to not only validate previous identification, but also to map the location(s) of interaction on each protein. The beauty of this system is that constructs are relatively easy to generate, and interaction of the proteins is determined by whether or not cells grow or show a certain phenotype (due to expression of the reporter gene).

Support: This work was supported by award 5P20GM104360 from the National Institutes of Health to AD, and award NSF-CAREER-1253723 from the National Science Foundation to SJH.

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RAPID SYNTHESIS OF N-(2,4-DICHLOROBENZYL)-N-METHYLFORMAMIDE

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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 4-chloro-benzaldehyde, a large amount of a by-product, N,N-di-(4-chlorobenzyl)-N-methylamine was produced with an isolated yield of 31.3%. N-(4-chlorobenzyl)-N-methylformamide was produced as the main product with an isolated yield of 52.0%.

Hypothesis: The reaction conducted on benzaldehydes with electron-withdrawing substituents may produce lower yields of the respective N,N-dibenzyl-N-methylamines. In this work, the hypothesis was tested by conducting the reaction on 2,4-dichlorobenzaldehyde.

Methods: The reaction was conducted on 10 mmol scale at 180ºC. 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 fully completed in 10 minutes. N-(2,4-dichlorobenzyl)-N-methylformamide and N,N-di-(2,4-dichlorobenzyl)-N-methylamine were isolated with the yields of 44.2% and 35.7%, respectively.

Conclusions: A new rapid method for the synthesis of N-(2,4-dichlorobenzyl)-N-methylformamide was developed.

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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EPIGENETIC REMODELING OF NON-SMALL CELL LUNG CANCER IN RESPONSE TO PROINFLAMMATORY CYTOKINES

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Lung cancer is the most frequent cause of death from cancer and non-small cell lung cancer (NSCLC) accounts for 85% of all lung cancer cases. Chronic inflammation has long been associated with cancer. However, the molecular mechanisms that link chronic inflammation and cancer progression are not yet well established. Src family of non-receptor tyrosine kinases, including a non-receptor Src tyrosine kinase Lyn, has been found to be upregulated in both inflammatory diseases and cancer. High expression of Lyn is associated with poor prognosis of lung, breast, prostrate, and renal cancer, among other cancers. Our lab studies the mechanism of transcriptional regulation of gene expression and I am specifically interested in analyzing the role of regulatory regions, such as enhancers and promoters, in Lyn and how modification of these regions can affect transcription by RNA polymerase II causing gene dysregulation. We propose that, proinflammatory cytokines cause epigenetic remodeling of the upstream enhancer region of Lyn gene, such that the subsequent upregulation of Lyn gene leads to cancer cell survival and proliferation. Our preliminary data show that treatment of lung cancer epithelial A549 cells, with lipopolysaccharide as well as purified pro-inflammatory cytokines causes upregulation of Lyn mRNA and protein expression. We will explore the role of enhancer region in regulating Lyn expression using various molecular, functional and biochemical techniques.

Support: NIH COBRE 1P20GM104360 and AI109317-01A1.

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A GENERATIVE DESIGN AND MANUFACTURING OF CUSTOMIZED HELMET

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While one concussion knocks players out from game, succession of it scratches literally them out from sports. Helmet is one of the main protective components, saves players from concussion. The existing head gears are standardized meaning 'One size fits all' which may not serve well protecting individuals. Our objective is to develop a generative sports helmet design ensuring smartness, player-specificity, and player-adaptability and allowing for realistic manufacturing of the prototypes.

Our engineered measurement and design approach will provide a quick and easy platform for customized shape digitization. Our recently developed customizable 3d printing equipment will be used to manufacture the helmet.

This research will allow manufacturer to select appropriate material, incorporate design criteria and even cost optimization in accordance to the individual player requirement.

Support: No financial support was provided for this work.

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RAPID SYNTHESIS OF N-(3-INDOLYLMETHYL)ACETAMIDE

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Background: Recently, we investigated acetamide as an alternative solvent for the Leuckart reaction. In reactions conducted on several substituted benzaldehydes, the respective benzylacetamides were isolated only as minor products with the yields of 10-15%. However, the reaction conducted on 2-hydroxybenzaldehyde produced N-(2-hydroxybenzyl)acetamide as the main product with an isolated yield of 32.9%.

Hypothesis: The presence of a hydroxyl group in benzaldehydes shifts the reaction from producing the respective benzylformamides towards producing the respective benzylacetamides. Because of the similarity between indoles and phenols, we may expect a similar shift from indolecarbaldehydes. In this work the hypothesis was tested by conducting the reaction on indole-3-carboxaldehyde.

Methods: The reaction was conducted on a 10 mmol scale at 195°C. Column chromatography was used for the isolation of the products of the reaction. NMR-spectroscopy and elemental analysis were used to determine the structure of the products.

Results: The reaction was fully complete in 6 minutes and produced N-(3-indolemethyl)-acetamide as a main product with a yield of 40.0%.

Conclusions: A new rapid synthesis for N-(3-indolylmethyl)acetamide was developed.

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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VASOACTIVE INTESTINAL PEPTIDE SIGNALING IS CRITICAL IN REGULATING SPLENOCYTE CELL NUMBERS

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Hematopoiesis is the development of erythrocytes and leukocytes within the bone marrow. Vertebrates require leukocytes for immune protection, and a complex interplay between soluble cytokines, hormones and neuropeptides regulates steady-state leukocyte numbers. Vasoactive intestinal peptide (VIP) is a neuropeptide delivered to primary and secondary immune organs that is also expressed by some immune cells. Its immunosuppressive, chemotactic and anti-proliferative activities are mediated by signal transduction through two G protein-coupled receptors (GPCR), designated VPAC1 and VPAC2. We hypothesized VIP/VPAC1 signaling deficiency would result in elevated leukocyte numbers as this receptor is expressed at a higher level (100-fold) compared to VPAC2 and is known to block cell cycle entry during T cell activation. To test this idea, we utilized knockout mice and measured spleen weights (which directly correlate with splenocyte numbers) on a scientific balance (Ohaus Voyager Pro Model VP64CN, sensitive to four decimal points). As expected, our results indicated that VPAC1 deficiency (N=25) showed an increasing spleen weight trend compared to age and gender matched wild type controls. Surprisingly, VPAC2 knockout mice also showed a similar trend. These data suggest that signaling through both GPCR molecules is critical to maintaining spleen weights. Future investigation will focus on determining which leukocyte subpopulations are altered due to the deficiency in VIP receptors.

Support: This work was supported by the National Institutes of Health (NIH) and the National Institute of Allergy and Infectious Diseases (NIAID).

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IN SILICO PREDICTION AND MODELING FOR POLYMERS, COATINGS AND DRUG LIKE MOLECULES

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Computerized models catalyze discoveries by crossing the boundaries between disciplines in addition to reducing the cost and time. Computational chemistry is the arsenal of the tool boxes comprising techniques for speedy and reliable prediction. We utilized these tools for modeling and prediction of properties of polymers in addition to molecular docking for prediction of binding energies and interaction of the drug like molecules with targets.

A Quantitative Structure Property Relationship (QSPR) has been a focus of interest for accelarted discovery of novel materials. We applied QSPR approach to establish a theoretical model for the prediction of the refractive indices and glass transition temperatures (Tg) of novel polymers. Predictive/validated QSPR models were generated by using two different data sets. A four–descriptor correlation was developed for the prediction of refractive indices with R^2=0.932, Q^2 Loo=0.914 by multilinear regression analysis. Virtual libraries of the novel polymers were designed and n values were predicted. A five-descriptor QSPR model was developed with the R^2=0.85 and Q^2loo=0. 74 by using 88 molecular structures with the values of Tg derived from various sources . The transition property values for external test set were predicted. Molecular docking was utilized to predict the binding energies and binding interaction to prioritize the compounds as useful urease inhibitors.

Support: This work was supported by US Department of Energy through Grant No. DE-SC0001717 are gratefully acknowledged.

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THE ROLE OF THE RPA2 N-TERMINUS IN GAMETE FORMATION

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Gamete cells (*e.g.*, sperm and eggs) containing a haploid genome content are produced by a process called meiosis. This process is essential for all sexually-reproducing organisms, and can easily be studied in the budding yeast Saccharomyces cerevisiae. One factor necessary for meiosis is the heterotrimeric protein complex Replication Protein A (RPA). This is probably due to the fact that RPA is required for proper DNA replication, repair/recombination, and cell cycle regulation, all important processes in meiosis.

Upon DNA damage, the Rpa2 (the 32-kDa subunit) N-terminus (NT) is phosphorylated; however, the function(s) of this domain remains to be determined. It has been hypothesized that the phosphorylation of the Rpa2 NT is important for DNA repair/recombination, although our recent data points more towards its primary function being in cell cycle regulation. Meiosis in yeast affords a great opportunity to test this, because during meiosis, repair of broken chromosomes through homologous recombination must occur at a high frequency due to the formation of hundreds of programmed double-strand breaks (DSBs). Work presented here focuses on the construction of strains containing Rpa2 NT mutants necessary to measure the repair of meiotic DSBs and to determine if the Rpa2 NT is actually important for this DNA repair.

Support: This work is supported by award NSF-CAREER-1253723 from the National Science Foundation to SJH.

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INVASIVE PLANTS INFLUENCE GRASSLAND BUTTERFLY COMMUNITIES

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Human-driven global change and management have altered the plant community in the Northern Great Plains. These alterations promote homogenization and facilitate exotic plant species invasions, generating changes in plant diversity, biodiversity at higher trophic levels, and ecosystem functions and services. Our objective was to determine if grassland butterflies, a group that contributes to several ecosystem services, are influenced by Kentucky bluegrass, an exotic plant species. We surveyed butterflies across 20 sites throughout North Dakota and South Dakota using line-transect distances sampling and collected flowering ramet density and plant community composition at all sites. We used linear mixed-effect modeling and non-metric multidimensional scaling ordination to conduct our analysis. After one year of data collection, we found an indirect relationship between butterfly richness and Kentucky bluegrass canopy cover ($R2 = 0.23$, $p = 0.03$). As the cover of Kentucky bluegrass increased, butterfly richness decreased. Similarly, butterfly habitat specialists were correlated with sites containing higher canopy cover of native forbs ($p = 0.01$) and less invasive plant species. Kentucky bluegrass inhibits the cover of native plants necessary for grassland butterfly populations. Therefore, management should focus on increasing native plant diversity and abundance to improve pollinator services that could be provided by the resulting diverse butterfly community.

Support: This work was supported by an award from the US Fish and Wildlife Service to RL, TH, JH, and KK and Prairie Biotic Research Small Grants to KK.

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UNDERGRADUATE RESEARCH RELATED TO ENVIRONMENT AND HUMAN HEALTH

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The project being conducted at Valley City State University (VCSU) since 2009 is oriented on environmental health aspects of coal fly ash utilization for plant media, and focuses on the utilization of coal fly ash (FA) for growing plants in to examine aspects of potential for plant cultivation, uptake of metals, and phytoremediation of FA. Coal FA is a major industrial by-product from electric power plants. Disposal of FA is becoming a major issue because of the potential to contaminate air, surface, and groundwater with arsenic, boron, heavy metals, sulphate anions, etc. A promising solution to the FA issue is phytoremediation, the use of green plants to clean up our environment. The principal objective of this research project is to study the potential use of FA as the medium for growing a variety of crops.

Student involvement is central to the project at Valley City State University. The major INBRE grant goal is to provide undergraduates with research experience, thus leading to their career development, including graduate and professional programs, especially at NDSU and UND. We use research as a very important learning tool, leading to the development of student's interests and better understanding of life sciences. In addition, cooperation with other faculty members and other institutions including ND Tribal Colleges and UND has been developed and maintained.

Each year 3-7 undergraduates from VCSU are involved in this project. Eight have decided to pursue graduate…

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 P20GM103442-13.

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VASOACTIVE INTESTINAL PEPTIDE SIGNALING REGULATES BONE MARROW CELL NUMBERS

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Hematopoiesis is the development of erythrocytes and leukocytes within bone marrow compartments. There is a dense array of nerve fibers innervating the bone marrow that supply these compartments with neuropeptides. It is well established that the nervous system regulates the differentiation, proliferation, and timing associated with hematopoiesis via daily circadian oscillations. Vasoactive intestinal peptide (VIP) is a master circadian regulating neuropeptide that is delivered to bone marrow by nerves and inhibits hematopoietic cell (HC) proliferation. VIP inhibits HC proliferation by eliciting signal transduction through one of its G protein-coupled receptors (GPCR), designated vasoactive pituitary adenylate cyclase activating peptide receptor 1 (VPAC1). Our lab hypothesized that a VIP/VPAC1 signaling deficiency would result in elevated bone marrow cells. To test this model, we utilized knockout mice and enumerated hematopoietic bone marrow cells from femur washes by manual cell counting on a hemocytometer visualized by light microscopy. Our results indicate that VIP deficiency results in elevated numbers of bone marrow cells that are statistically significant when compared to age and gender matched controls. Surprisingly, femurs obtained from VPAC1 knockout mice contain similar amounts of bone marrow cells compared to their wild type counterparts. Interestingly, VPAC2 knockout mice, a second VIP GPCR, show elevated bone marrow cells compared to age-matched controls…

Support: Financial Support was provided by NIH/NIAID.

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RAPID SYNTHESIS OF N-METHYL-N-(1-NAPHTHYLMETHYL)FORMAMIDE

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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 piperonal (3,4-methylenedioxybenzaldehyde), a large amount of a by-product, N-methyl-N,N-dipiperonylamine was produced with an isolated yield of 32.8%. N-methyl-N-piperonylformamide was produced as the main product with an isolated yield of 51.4%.

Hypothesis: The reaction conducted on electron-donating aromatic aldehydes may produce higher yields of N,N-diaryl-N-methylamines) and lower yields of N-aryl-N-methylformamides. In this work the hypothesis was tested by conducting the reaction on 1-naphthaldehyde.

Methods: The reaction was conducted on 10 mmol scale at 185ºC. 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 fully completed in 1 minute. N-methyl-N-(1-naphthylmethyl)formamide was still produced as the main product but with a slightly lower isolated yield of 46.0%. N-methyl-N,N-di-(1-naphthylmethyl)amine was produced with a slightly higher isolated yield of 34.9%.

Conclusions: A new rapid method for the synthesis of N-methyl-N-(1-naphthylmethyl)-formamide was developed.

Support: The project was supported by NIH grant 8 P20 GM103442-12 from the National Institute of General Medical Sciences.

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PRELIMINARY CARCINOEMBRYONIC ANTIGEN APTAMER SEQUENCES IDENTIFIED THROUGH GO-SELEX

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Carcinoembryonic antigen (CEA) is a type of glycoprotein that was first discovered in the 1960s. Initially it was thought that CEA was only present during fetal development and was not present in adults, this however was proven false since healthy adults have concentrations of CEA measuring less than 2.5 ng/mL. However, in the presence of various cancers, CEA concentration raises, thus making it a potential biomarker for: lung, breast, ovarian and pancreatic cancer. Many studies have been conducted for the design of early cancer detection and a way that this can be done is through the use of biomarkers, such as CEA. Biomarkers can be detected through many different of methods but a rising interest is through the use of aptamers. Aptamers are short single stranded DNA sequences that are specific and selective toward their target and are identified through systematic evolution of ligands through exponential enrichment (SELEX). In this study, using graphene oxide assisted SELEX (GO-SELEX) after 6 rounds of selection identified multiple CEA aptamer sequences. This is the first step into making a multiple detection method for early cancer screening. By combining CEA with another biomarker more specific toward the cancer of chosen study, a multiplex detection method could be made for early cancer screening.

Support: NIH-R21CA137703.

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ENERGY IMPACTS ILLUSTRATED: LANDSCAPE INDUSTRIALIZATION IN THE BAKKEN OIL PATCH

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Energy production has surged in the Bakken region of western North Dakota since 2007. Although oil production has long been a feature of western North Dakota, new technologies such as hydraulic fracturing and horizontal drilling have led to unprecedented landscape industrialization. The region is isolated, and development impacts have not been well-studied. To identify concerns of citizens of the Bakken and determine how land-grant university researchers might support them, we conducted a two-part study: First, we conducted focus groups with resource management and community leaders in three major oil-producing counties. Second, we used an outline of the major concerns expressed by focus group members as a survey for landowners and farm/ranch operators. We found little relationship between survey respondents' reported categorization of energy impacts and actual land area impacted, suggesting factors such as attitude towards development, degree of compensation, and level of disturbance are relevant. Landowners agreed with focus groups on the nature of relationships between energy companies and locals and development impacts on infrastructure and communities; those reporting greater impacts tended to agree more strongly. But many specific problems described in focus groups were not widely reported in the survey, suggesting energy-community relationships can be improved through state-level public policy and respect from energy companies for locals and their way of life.

Support: North Dakota State University Office of the President; North Dakota Agricultural Research Station (Main Station and Dickinson Research Extension Center)

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ASSESSING THE SPATIAL EXTENT AND EFFECTS OF FUGITIVE ROAD DUST IN THE BAKKEN REGION OF NORTH DAKOTA

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The Bakken region of North Dakota has undergone rapid energy development following the introduction of hydraulic fracturing and horizontal drilling. This combination of activity and techniques accounts for a shift in the amount and type of traffic on unpaved roads throughout the primarily rural region. Previous research indicates that fugitive road dust deposition can decrease plant performance. Our objective is to determine: 1) the spatial extent of dust deposition, 2) how traffic and weather influence deposition, and 3) effects of fugitive road dust deposition on plant performance. We installed arrays of marble-pan dust traps to collect fugitive dust at increasing distances from an unpaved road in 6 crop fields (5 wheat, 1 corn) spread across Dunn and McKenzie counties. Traffic counters and weather stations were also installed at the crop fields for the duration of dust collection. Plant performance parameters were measured in each field at the same distances that dust traps were installed. The results from the first field season suggest that dust deposition substantially decreases between 90-180 m from an unpaved road. For the most part, fields with higher amounts of traffic should expect higher deposition rates of fugitive dust. Wind direction and orientation explain discrepancies in deposition between adjacent fields with identical traffic. Initial plant performance data suggests precipitation can mitigate dust impact on vegetation by preventing foliar accumulation

Support: The authors would like to thank the North Dakota State University Office of The President, North Dakota Agricultural Experiment Stations (Main Station and Dickinson Research Extension Center), and North Dakota Idea Network of Biomedical Research Excellence for supporting this project.

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PIPERLONGUMINE ENHANCES THE EFFICACY OF GEMCITABINE IN PANCREATIC CANCER CELLS IN VITRO AND IN VIVO

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Reactive oxygen species (ROS)-inducing agents have been identified as possible treatments for various cancers, including pancreatic cancer. Cancer cells have high levels of ROS compared to healthy cells due to excessive metabolic activity. This phenomenon makes ROS a viable target for cancer treatment. We investigated the effect of a known ROS inducer, piperlongumine (PL), a bioactive agent found in long peppers, alone and in combination with a chemotherapeutic agent (gemcitabine; Gem) on pancreatic cancer cells in vitro and in vivo. The pancreatic cancer cell line (MIA PaCa-2) was treated with PL, gemcitabine, or a combination of the agents to evaluate the effect of PL on enhancing the efficacy of gemcitabine. Cell survival was assessed by 3-(4, 5-dimethylthiazol-2-yl)-2, 5-diphenyltetrazolium bromide (MTT) and propidium iodide (PI) staining, and Matrigel, and wound healing assays were performed. Our in vitro results show (MTT assay); 1uM of PL causes a 90% reduction in cell viability, 1nM of gemcitabine causes a 86% reduction, and the combination of PL (1uM) + gemcitabine (1nM) causes a 66.7% reduction compared to control (normalized to 100%). The PI staining (cell membrane integrity) control was 81% viable, 2.5uM PL treatment was 39.4% viable, 100nM gemcitabine treatment was 69.4% viable, and the combination PL (2.5uM) + gemcitabine (100nM) treatment was 36% viable. For the Matrigel and wound healing assays we observed a significant reduction number of cells and wound d…

Support: P30 GM103332-01 National Institute of Health.

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AVIAN CONSERVATION IN WORKING LANDSCAPES: THE EFFECTS OF GRAZING MANAGEMENT ON GRASSLAND BIRDS

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Rangelands cover more than 30% of the terrestrial surface in the United States and encompass diverse native communities that provide essential ecosystem services. To conserve rangeland biodiversity, ecologists need to develop a better understanding of how management practices affect grassland fauna. We addressed this challenge by comparing tallgrass prairie bird communities across various grazing regimes (season-long, rotational, and patch-burn grazing) in the Sheyenne National Grassland of North Dakota. We used line transect surveys to sample the breeding bird community in each grazing treatment. We then calculated bird diversity and used Program DISTANCE to obtain abundance estimates. We detected 11 grassland-obligate and 14 grassland-facultative species. Species most commonly observed were Grasshopper Sparrow, Bobolink, Savannah Sparrow, and Western Meadowlark. After one year of data collection, no treatment effect on grassland obligate abundance or diversity was apparent. As treatment application continues, we expect plant communities across grazing regimes to diverge, resulting in greater differences among bird communities. Additionally, springtime precipitation was at a record high in 2015, which led to surplus forage production and likely limited differences among treatments. Upon completion of this study, we will use our results to develop practical recommendations for incorporating avian conservation into rangeland management plans.

Support: No financial support was provided to SMN, TJH, or RFL for this work.

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SAND FRACTION LITHOLOGY OF SEDIMENT AT AN ARCHAEOLOGICAL SITE IN GRAND PORTAGE, MINNESOTA

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Grand Portage National Monument is a National Park Service unit located in Grand Portage, Minnesota. The park is rich in archeological sites, with several sites located along the shores of Lake Superior. In 2014, an excavation took place on a site that is currently eroding into the lake. The excavation revealed two distinct sandy sediment layers of different colors, both of which contained artifacts. The stark difference between the two layers has caused controversy among researchers because some believe that the upper layer is fill dirt, rather than a natural deposit.

The goal of this project is to use sand fraction analysis to investigate the lithological characteristics of both of the sandy layers at the shoreline site. This analysis should help to determine whether or not the layers are related. Twenty-two sediment samples were wet-sieved to retrieve the 1-2 mm sand fraction. Sands were examined under a microscope and counted into nine lithology classes. Data were statistically analyzed using a two-tailed T test to determine significant differences.

Results of the analysis indicate that no significant differences exist in lithology between the two sediment layers. These data suggest that the upper layer is not fill, and that the color difference is likely due to natural soil forming processes.

Support: Financial supported provided by Student Oppurtunities For Academic Research (SOAR).

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RAPID SYNTHESIS OF N-(4-T-BUTYLBENZYL)-N-METHYLFORMAMIDE

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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 4-chlorobenzaldehyde, a large amount of a by-product, N,N-di-(4-chlorobenzyl)-N-methylamine was produced with an isolated yield of 31.3%. N-(4-chlorobenzyl)-N-methylformamide was produced as the main product with an isolated yield of 52.0%.

Hypothesis: The reactions conducted on benzaldehydes with electron-donating substituents may produce larger amounts of the respective N,N-dibenzyl-N-methylamines. In this work, the hypothesis was tested on 4-t-butylbenzaldehyde.

Methods: The reaction was conducted on 10 mmol scale at 184˚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.

Result: The reaction was completed in 2 minutes. N,N-di-(4-t-butylbenzyl)-N-methylamine and N-(4-t-butylbenzyl)-N-methylformamide were isolated with the yields of 25.9% and 35.7%, respectively. The molar ratio of the by-product to the main product increased from 6:10 to 7:10.

Conclusion: A new rapid method for the synthesis of N-(4-t-butylbenzyl)-N-methylformamide was developed. N-(4-t-butylbenzyl)-N-methylformamide can be used in the synthesis of butenafine.

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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MOTILITY TESTING OF ESCHERICHIA COLI RECOVERED FROM A BIOFILM

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Within the flagellar region of E. coli, there are 14 operons that control expression of genes coding for flagellar motility with a master operon that directly controls all other operons in the region. The flhD master operon that contains the flhD and flhC genes must both be expressed for flagella to be present in the E. coli strain. When E. coli form a biofilm, they transition to a non-motile state that is more conducive to growth by adherence where motility is not needed. When bacteria are recovered from these biofilms they should resume normal patterns of motility. Non-motile colonies were recovered from a month old MC1000 biofilm. The purpose of this experiment is to find if the mutation that is affecting motility is in the flhD operon by inserting a plasmid that expresses flhD and flhC (designated pXL27) into the bacteria via transformation.

The non-motile isolates of MC1000 E. coli that were previously recovered from biofilm were plated from frozen stocks onto LB media. Isolated colonies were then transferred to a LB broth culture for overnight growth, and placed into fresh media for growth; the bacteria were harvested at about mid-log phase and made competent using the “Classical” CaCl2 Method2. Each competent isolate (100 µl) and 2 µl of pXL27 plasmid was placed in 42°C water baths for heat shock to cause plasmid uptake. These were then transferred into a tube of 900 µl of SOC growth media and incubated for 2 hrs at 37oC to allow cell recovery, after which the …

Support: None listed.

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CROPS PERFORM POORLY AT EXTREMELY LOW AND EXTREMELY HIGH LEVELS OF ATMOSPHERIC CARBON DIOXIDE

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Agricultural scientists are concerned about the effects of rising carbon dioxide levels on the performance of food-producing plants. Plants with different photosynthetic pathways might respond differently to atmospheric carbon dioxide due to differences in carbon use efficiency. This question is particularly relevant to North Dakota because both crops and rangeland in the state are a mix of plants that use the C3 and C4 photosynthetic pathways. We compare 10 species grown at three CO2 levels -- 100 ppm, 450 ppm (ambient), and 1000 ppm -- to determine plant growth at the extremes of atmospheric CO2 to determine appropriate levels for future experiments. We focused on economically important annual crops, and selected five C3 species (barley, quinoa, ryegrass, oats, wheat) and five C4 species (amaranth, foxtail millet, maize, proso millet, sorghum). At each level, seedlings were grown in the growth chamber for four weeks and sampled weekly for shoot/root biomass and leaf area. In general plants performed best at ambient levels of CO2, indicating that future experiments should use less extreme concentrations. Ratio of root biomass generally increased at low CO2 levels, due to reduced shoot production. Although shoot biomass was consistently greater at ambient CO2, when species showed a difference between low and high CO2 (amaranth, oats, quinoa, and wheat), growth was greatest at low CO2, highlighting the concern for elevated CO2 on food security.

Support: North Dakota Agricultural Experiment Station, North Dakota State University College of Agriculture Duncan Scholarship Program

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ROLE OF RAGE IN DEVELOPMENT OF PANCREATIC CANCER

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The Receptor for Advanced Glycation End products (RAGE) is known to trigger multiple intracellular signaling pathways in cancer and several other diseases. Many of the recent studies demonstrate that RAGE contributes towards cell survival, proliferation, drug resistance and the high metastatic potential of pancreatic cancer cells.

Our objective is to investigate the role of RAGE in pancreatic cancer progression. For this we forcefully express RAGE in various pancreatic cancer cells like Panc-1 and MIAPaCa-2. We will next compare the cellular properties, like proliferation, migration and invasion, of these new cell lines with the wild-type cell lines. We also intend to study if the RAGE ligands AGE and S100P, also contribute towards advancement of pancreatic cancer in cooperation with the receptor.

We have generated pancreatic cancer cells lines that overexpress RAGE. We estimated the expression of RAGE at transcript as well as protein level. Our preliminary results show that overexpression of RAGE in pancreatic cancer cells can lead to enhanced proliferation of cells as compared to the wild-type cells. Also in presence of the AGE ligand, an increase in proliferation was observed.

Understanding RAGE signaling mechanism could lead to the development of new therapeutic strategies in pancreatic cancer.

Support: This work was supported by Grant #5P30GM103332 COBRE Center for Protease Research.

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GROUND STATE PROPERTIES AND NONADIABATIC DYNAMICAL STUDIES OF LEAD CHALCOGENIDE CORE/SHELL QUANTUM DOTS

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Core/shell quantum dots (QDs) have attracted much interest among experimentalists and theoreticians in recent years due to their unique characteristics (e.g., in reducing or eliminating fluorescence quenching as well as optical blinking, introducing carrier multiplication, and in opening up new absorption/relaxation channels not present in the respective core or shell materials). Here, we present DFT and TDDFT studies of $Pb_{16}X_{16}/Cd_{52}Y_{52}$ (X, Y = S, Se, Te) Core/Shell quantum dots (QDs). We examined the ground state properties of these systems (i.e., the optimized geometries, density of states, projected density of states, and optical absorption spectra). Most of the heterostructures were analyzed for the first time (e.g., $Pb_{16}S_{16}/Cd_{52}Te_{52}$ and $Pb_{16}Te_{16}/Cd_{52}Se_{52}$). We found the thin shell core/shell QDs to be largely borderline type II with much similarly between QDs containing $Cd_{52}S_{52}$ and $Cd_{52}Se_{52}$ shells, whereas core/shell QDs with a $Cd_{52}Te_{52}$ shell appeared to be borderline type-I. All shells were found to enhance the optical properties of the lead chalcogenide cores, brightening initially dark lowest energy transitions. In optimized geometries of the studied QDs, the $Pb_{16}X_{16}$ cores largely retained their bulk structures, whereas the relaxed shells assumed a somewhat spherical geometry due to surface reconstruction. We are currently performing nonadiabatic DFT-based dynamics, coupled with the surface hopping method, to investigate fates of excited electrons or holes in these systems.

Support: None listed.

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RAPID SYNTHESIS OF N-(3-INDOLYLMETHYL)-N-METHYLFORMAMIDE

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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 piperonal (3,4-methylenedioxybenzaldehyde), a large amount of a by-product, N-methyl-N,N-dipiperonylamine was produced with an isolated yield of 32.8%. N-methyl-N-piperonylformamide was produced as the main product with an isolated yield of 51.4%.

Hypothesis: The reaction conducted on electron-donating aromatic aldehydes may produce higher yields of N,N-diaryl-N-methylamines) and lower yields of N-aryl-N-methylformamides. In this work the hypothesis was tested by conducting the reaction on 3-indolecarboxaldehyde.

Methods: The reaction was conducted on 10 mmol scale at 183ºC. 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 fully completed in 10 minutes. Currently, N-(3-indolylmethyl)-N-methylformamide is the only isolated product with a yield of 39.8%. Work on isolating N,N-di-(3-indolylmethyl)-N-methylamine is underway.

Conclusions: A new rapid method for the synthesis of N-(3-indolylmethyl)-N-methylformamide was developed.

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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DOWN-REGULATION OF BIOENERGETICS IN A CELLULAR MODEL OF FRIEDREICH ATAXIA

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Friedreich's ataxia (FRDA), an inherited, progressive neurodegenerative disease, is caused by a reduced expression of the mitochondrial iron-binding protein, frataxin. To study the pathophysiological mechanism of how frataxin deficiency causes the devastating disease, we created a cellular model of FRDA by stably knocking down frataxin in glioma LN428 cell line. The expression level of frataxin in knockdown cell lines was about 25% of that of control. Both OXPHOS and glycolysis were significantly down-regulated in frataxin knockdown cells by ~40%. Reduction in these two bioenergetic pathways reduced steady-state ATP levels by 1.6 fold. Western analysis indicated that Fe/S containing subunits in complex I, II and III were decreased by 1-2 fold in response to frataxin deficiency. Reduced protein levels of these subunits affected the assembly of complexes and the formation of supercomplexes, as observed by Blue- Native Gel Electrophoresis. The activities of aconitase were also reduced by 2 fold in response to frataxin deficiency. PDK1, a protein kinase that phosphorylates and thus inactivates pyruvate dehydrogenase alpha subunit, was more than 2-fold overexpressed in frataxin knockdown cells. Thus, at three key steps of respiration, including pyruvate entry into TCA cycle, the TCA cycle and OXPHOS, cells down-regulated their activities in response to frataxin deficiency. We conclude that down-regulation of bioenergetics is an important mechanism for the pathological development…

Support: None listed.

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DCB: Dakota College at Bottineau
DSU: Dickinson State University
JU: Jamestown University
LRSC: Lake Region State College
MiSU: Minot State University
MaSU: Mayville State University
NDSCS: North Dakota State College of Science
NDSU: North Dakota State University
TMCC: Turtle Mountain Community College
UND: University of North Dakota
VCSU: Valley City State University
WSC: Williston State College

USDA: US Department of Agriculture
USFW: US Fisheries and Wildlife Services

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

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 (nonmember 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

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.

BYLAW12. *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.

BYLAW13. *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
Past-President
President-Elect
Secretary-Treasurer (three-year term)
Councilors (three-year term)

President

Stuart J. Haring
Chemistry and Biochemistry
North Dakota State University
NDSU Dept 2710
PO Box 6050
Fargo, ND 58108-6050
701-231-7945
stuart.haring@ndsu.edu

Past-President

see President

President-Elect

Julia Xiaojun Zhao
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University of North Dakota
Abbott Hall, Rm 132
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701-777-3610
julia.zhao@und.edu

Secretary-Treasurer

Bryan Schmidt (2014-17)
Division of Science – Chemistry
Minot State University
500 University Ave W
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701-858-4250
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Councilor

Andre Delorme (2014-17)
Math, Science, and Technology
Valley City State University
Rhoades Science Center, Rm 203D
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andre.delorme@vcsu.edu

Councilor

Douglas Munski (2013-16)
Geography
University of North Dakota
Ireland Hall, Rm 152
221 Centennial Dr, Stop 9020
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douglas.munski@und.edu

Councilor

Stuart J. Haring (2016-2019)
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Fargo, ND 58108-6050
701-231-7945
stuart.haring@ndsu.edu

COMMITTEES OF THE NORTH DAKOTA ACADEMY OF SCIENCE

Executive Committee	Stuart J. Haring, North Dakota State University Julia Xiaojun Zhao, University of North Dakota Bryan Schmidt, Minot State University Andre Delorme, Valley City State University Joseph Hartman, University of North Dakota Douglas Munski, University of North Dakota
Editorial Committee *	
Education Committee	Douglas Munski, University of North Dakota
Denison Awards Committee *	
Necrology Committee *	
Nominating Committee	
State Science Advisory Committee *	
Resolutions Committee	Kaylee Dockter, Minot State University Joel Collins, Minot State University Paul Lepp, Minot State University
Membership Committee *	
Audit Committee *	
North Dakota Research Foundation – Board of Directors	Birgit Pruess, North Dakota State University Jerzy Bilski, Valley City State University Paul Lepp, Minot State University
Historian	Alexey Shipunov

* Indicates currently available openings.

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

Year	President	Location
1909	M. A. Brannon	Grand Forks
1910	M. A. Brannon	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
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

Year	President	Location
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	Wyoming
2013	Keith Henry	Grand Forks
2014	Jerzy Bilski	Valley City
2015	Stuart J. Haring	Fargo

MINUTES OF THE NORTH DAKOTA ACADEMY OF SCIENCE

ANNUAL BUSINESS MEETING 2015

President Haring called the annual business meeting to order in the Arikara Room of the Memorial Union on the campus of North Dakota State University in Fargo, North Dakota on April 25th, 2015 at 1:04 PM. President Haring welcomed all and thanked them for their attendance.

With President-Elect Fisher not in attendance, President Haring lead a discussion on the selection of days for holding the 108th Annual Meeting of the Academy in 2015. The meeting will once again be held in Memorial Union on the North Dakota State University campus. President Haring offered several potential dates for the 2016 meeting: March 23-24, April 14-15, or April 21-22. The majority of members present had a preference for a Friday/Saturday meeting rather than Thursday/Friday or over a weekend. There was also discussion of the proximity of the Academy to other meetings, such as the ND EPSCoR meeting. Most members present had a preference for scheduling the Academy meeting immediately prior to or post another meeting to increase attendance at both meetings. The dates for the 180th Annual Meeting in 2016 were selected as April 15-16.

President Haring requested registration for the 2016 Annual Meeting will only be offered in advance, with no on-site registration. The purpose of this request was to allow for better planning of room size and catering. An option for late registration was proposed that would incur and increased registration fee, but this late registration must still be at least two weeks in advance to allow for finalization of catering plans. Other suggestions for improvement for the 2016 Annual Meeting included fixing registration confirmation on the website. It was noted that all submitted abstracts are accepted, according to the Academy constitution. An improved registration process that includes additional features, such as ability to request a parking pass, type of meal, and option to chair a session. An option to register for one or both days was also discussed, but rejected to encourage maximum participation in the entire meeting.

The Academy budget was presented by Secretary-Treasurer Schmidt. There is currently $9,000 in the Academy checking account and another $2,000 in the PayPal account. This does not include the expenses incurred for the current Annual Meeting, which are approximately $3,500-4,000. There is currently approximately $4,000 in the Scholarship Fund, $10,000 in the Research Foundation Fund, and $135,000 in stock holdings. It was proposed that in addition to individual Academy memberships, Institutional Memberships also be offered. Cost of Institutional memberships should be proportional to the size of the institution, and would encourage more involvement of tribal and community colleges. Institutional membership would not be required, but could be a means of guaranteeing attendance. Travel Scholarships could also be offered for institutions that won't buy into institutional memberships. The Executive Committee was charged with devising a plan for individual and institutional memberships. Dr. Pruess, member of the North Dakota Research Foundation Board of Directors, made suggestions for spending of Research Foundation funds. Dr. Pruess recommended offering two $500 research awards per year to UND and NDSU and another eleven $300 research awards to other participating institutions. Another award could be offered for Native American participation. There was also a proposal to have a Student

Ambassador at each participating institution. This Ambassador would be charged with increasing student participation at their institution and in exchange would receive free registration at the next Annual Meeting. The Executive Committee was charged with implementation or rejection of a NDAS Student Ambassador program.

Nominations were held for unfilled Officer positions. Dr. Julia Zhao from UND was elected the incoming President-Elect for 2017, to be assisted by Dr. Joseph Hartman. Dr. Stuart Haring was elected as Councilor to replace Dr. Joseph Hartman whose term was expiring.

There were 5 professional talks, 18 Denison graduate student talks, 8 Denison undergraduate student talks and 18 poster presentations. The Denison Awards were presented by President Haring. The Denison Award winners were:

	Undergraduate Awards		**Graduate Awards**	
Place	Recipient	Award	Recipient	Award
2nd runner-up	Shannon Hone	$100	Meredith Irsfeld/Tim Wilson	$75
1st runner-up	Kaylee Dockter	$150	Danielle Krout	$150
Winner	Alisa Heskin	$200	Xu Wu	$200

At 2:17 PM, Dr. Bryan Schmidt motioned to adjourn the meeting. Dr. Stuart Haring seconded the motion. The motion carried and the meeting was adjourned.

Respectfully submitted,
Bryan Schmidt, Secretary-Treasurer

LIFETIME MEMBERS

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