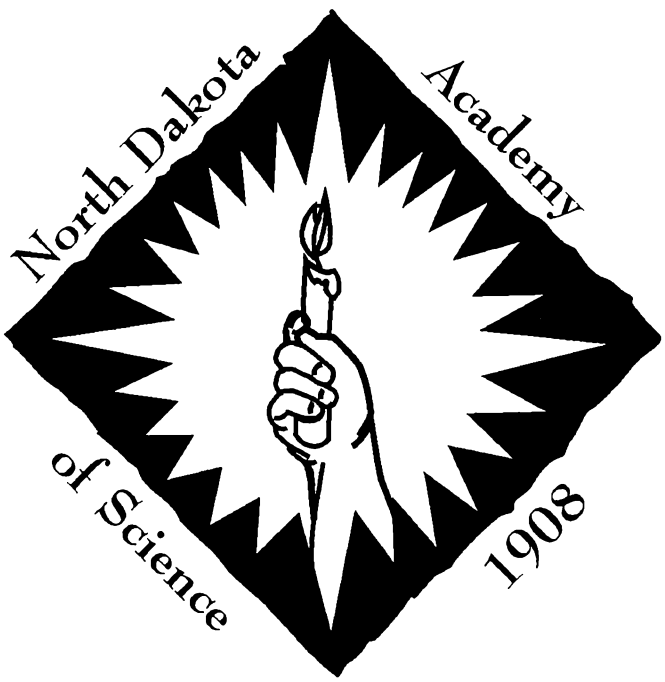
North Dakota Academy of Science

Proceedings of the 95th Annual Meeting

Minot State University

March 2003
Volume 57



Proceedings
of the
North Dakota Academy of Science

(ISSN 0096-9214)

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North Dakota Academy of Science
P.O. Box 7081, University Station
Grand Forks, ND 58202-7081
U.S.A.

Typesetting: Terrifying Typesetting Service, Merrifield, ND

PROCEEDINGS
OF THE
NORTH DAKOTA ACADEMY OF SCIENCE

Volume 57 March 2003

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

2002-2003

95th Annual Meeting
March 27–28, 2003
Conference Center - Minot State University
Minot

HISTORY

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

In 1979 (Volume 33) the *Proceedings* changed to the present 8 ½ x 11-inch format. It was produced from camera-ready copy submitted by the authors and issued in a single part to be distributed initially at the annual meeting. Commencing with Volume 51 all submissions were on computer disk; the entire *Proceedings* was then assembled by desktop publishing software. This approach allowed the Editor control over all formatting; many of the papers are reformatted in order to give the *Proceedings* a more consistent look. Also, incorporating all of the submissions on computer allowed production of an electronic copy of the *Proceedings* for the first time. Thus, the current Secretary-Treasurer has the capability to generate electronic copies of issues 55 through the present.

VOLUME 57 ORGANIZATION

This year the council of the NDAS decided to accept for publication the abstracts of all presentations scheduled for the 95th Annual Meeting. This meant that the communications of this volume did not undergo the standard level of peer review, but rather were chosen to given an accurate and up-to-date reflection of the material presented before the membership of the Academy at the Annual Meeting in Minot. As a result, the presentations featured in this year's ***Proceedings*** are presented in three major themes or sections. The first section contains the communications presented as part of the Symposium of Biomedical Research Infrastructure Network (BRIN) researchers and their projects. The second section comprises collegiate communications presented in the A. Rodger Denison Student Research Paper Competition. A third section comprises the remaining undergraduate and graduate presentations. The final sections and second section of this volume contains the communications presented in the professional sections of the annual 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 57.

Symposia Communications

Commencing with the 88th Annual Meeting [Volume 50], presenters of Symposia annual meetings have been given the opportunity to contribute an expanded or full-length article consisting of a multiple-page contribution, thus providing a presentation of much greater depth and scope than possible in a singe-page communication.

This approach has allowed speakers to present more educationally-oriented lectures or workshop-type discussions and still provide a rigorous and/or more technical professional paper to the Proceedings. In a few cases, a speaker does not have a written communication. Again, this approach was taken to allow the symposia convenors the greatest flexibility possible in organizing speakers for the benefit of the audience.

Collegiate and Professional Communications

Each Collegiate and Professional presentation at the annual meeting is represented by a full-page communication that is more than an abstract, but less than a full paper. The communications contain results and conclusions, and permit the sharing of important data and conclusions. The communication conveys much more information to the reader than does an abstract, and yet still provides the advantages of timeliness and ease of production.

Constitution and Bylaws

This issue of the Proceedings also contains the Constitution and Bylaws of the Academy, a list of officers and committee members, a list of all current dues-paying members of the Academy as of December 2002, a copy of unapproved minutes from last year's annual business meeting, a listing of past presidents of the Academy, and an index of presenters and paper authors.

IN APPRECIATION

The Academy wishes to acknowledge current and emeritus members of the Academy who have supported the mission of the North Dakota Academy of Science Research Foundation through their special gifts. A listing of these supporters is found on page 48 of these Proceedings. 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. The President of the Academy also wishes to sincerely thank Dr. Mary Ann Sens, Chair of the Department of Pathology and the University of North Dakota School of Medicine, for speaking at this year's awards banquet.

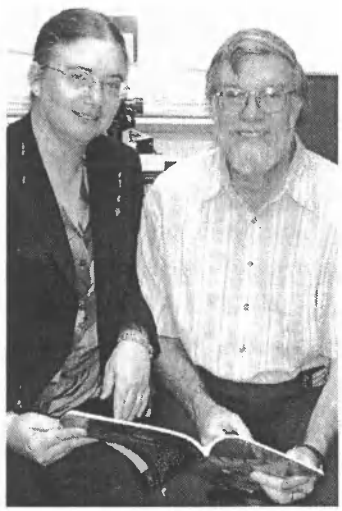
Jon A. Jackson
Secretary-Treasurer
Proceedings Editor

Richard Barkosky
President

UND research team studies biomarkers to discover new clues for treating cancer

GRAND FORKS, N.D. - In the battle against cancer, researchers are studying how cancerous cells provide clues known as biomarkers that can help doctors diagnose and treat their patients more effectively.

Mary Ann (M.D., Ph.D.) and Donald (Ph.D.) Sens, a husband-and-wife research team at the University of North Dakota School of Medicine and Health Sciences, say that when some types of cancer cells overproduce a specific protein, the information can be used to determine the cancer's stage of development and how aggressively to treat it.



The Sens' two cancer research projects - both funded by the National Institutes of Health (NIH) - relate to a protein called metallothionein (pronounced met-aloe-THIGH-oh-neen). Normally, cells produce metallothionein to protect themselves from cadmium, a toxic heavy metal. In their research, the Sens have found that metallothionein is overexpressed in some human cancers.

"What we do is study samples of human tissue and ask how the expression of this protein correlates to how a cancer operates," says Donald. "It becomes important in breast, bladder and prostate cancers. By identifying biomarkers, we try to define the seriousness of an early cancer, which determines whether to treat it very aggressively or not as aggressively."

In their search for cancer-related biomarkers, the Sens rely on excess diagnostic human tissue samples that have been discarded as medical waste. Using these samples, they have developed models of tumor cell lines, enabling them to bypass animal testing.

"This is called retrospective research because we're looking at samples from pre-existing specimens," says Mary Ann, a pathologist and chair of the Department of Pathology at the UND medical school. "When we test a new biomarker for prostate cancer, we need to determine if it can predict what will happen.

"I look at the tissue sample under a microscope to see if it has a certain protein. If it does, I ask whether it makes a difference. I already have the answer because I'm looking at a sample from 20 years ago and I know what happened to the patient."

The Sens' research could influence the decisions doctors make about how cancers are treated today.

"With the information biomarkers provide, we can say, yes, this is a bad cancer or, no, this cancer is not going to progress," Donald explains. "We also know that when metallothionein is overexpressed, it interferes with Cisplatin, a chemotherapy drug used to treat cancer patients."

In addition to research on using biomarkers as a diagnostic tool, the Sens have a second NIH grant to study the cause of metallothionein overexpression in the kidneys and what happens when it occurs.

"We use our tissue culture models in the lab to manipulate genes and discover how a biomarker really works," says Donald. "We take the metallothionein gene, put it in a cell that doesn't normally have it and see what happens.

Continued on next page ☞

Continued from previous page ☞

"We're attempting to prove that it starts binding up all the extra zinc in the cell because zinc is very similar to cadmium. But to live, you need zinc as a mineral," he says. "When metallothionein takes zinc from many other proteins that need it, the cell loses its proper mechanism for growth control."

Some of the Sens' work on the metallothionein protein as a biomarker has been published in the American Journal of Pathology (Metallothionein Isoform 3 Overexpression Is Associated with Breast Cancers Having a Poor Prognosis - July 2001) and Environmental Health Perspectives (Metallothionein Isoform 3 as a Potential Biomarker for Human Bladder Cancer - March 2000).

Mary Ann Sens became the chair of the medical school's pathology department last August. She and Donald came from the University of West Virginia, bringing with them a research team that includes assistant professors Scott Garrett, Ph.D., and Seema Somji, Ph.D., and graduate students Volkan Gurel and Seongmi Park, as well as two, $1.2 million NIH research grants, each for four years.

H. David Wilson, M.D., vice president for health affairs and dean of the medical school at UND, says bringing in the Sens and their research team transforms a department that was traditionally focused on education to one engaged in both education and research. Helping to make it possible was start-up funding for new faculty from the North Dakota Biomedical Research Infrastructure Network (BRIN) through the state's Experimental Program to Stimulate Competitive Research (EPSCoR).

"The start-up package, including the funding from BRIN, was very helpful," says Wilson. "Our commitment to the Sens includes whatever they need from the medical school standpoint, plus the assistance from BRIN and EPSCoR. Putting all of our funding dollars together obviously made us very competitive."

Donald Sens says, "We had two young people in our laboratory who were extremely good and this was an opportunity to bring them along. North Dakota wanting to develop research was a unique opportunity to move the program without disrupting it."

"With Mary Ann and Donald Sens, we have high quality people who are going to be here for the long haul. Suddenly, we're thought about on the national map," says Wilson.

Thanks to Patrick Miller, ND BRIN Information Officer, for permission to include his feature article on Mary Ann and Don Sens in the ***PROCEEDINGS OF THE NDAS***.

Make plans now for you and your students
to attend the
96th Annual Meeting of the
North Dakota Academy of Science,
April 2004 in Fargo.

So what is BRIN anyway?

North Dakota BRIN's purpose is to build biomedical research capacity within the state. Networking and human resource development are the watchwords for this collaborative effort between the two North Dakota research universities, four baccalaureate institutions in the North Dakota University System and five tribal community colleges.

Objectives

It is anticipated that by the end of the granting period, North Dakota BRIN will have established sustained and meaningful collaborative interactions between participating institutions in the realm of biomedical research capacity building. Long-term outcomes include an increase in biomedical research competitiveness and an increase in the number of college graduates entering into biomedical research careers.

Core Areas

Four core areas will accomplish the BRIN goals.

- A Bioinformatics Core will establish a statewide consortium of libraries to coordinate the acquisition of and access to electronic biomedical literature, databases and bioinformatics software. It will also establish a computational chemistry and biology network to serve biomedical research in the state.
- A Start-up Core will enhance recruitment packages needed to attract new talented young or senior biomedical scientists to the two research universities.
- A Tribal College/Baccalaureate Science Core will focus on increasing the pipeline of science graduates seeking careers in biomedical research. Tribal colleges will strengthen science instruction through curriculum development and utilization of videoconferencing for distance learning. Baccalaureate institutions will encourage student-oriented research projects, assist in science faculty recruitment and expansion, and participate in a scientist exchange program with the research universities. A graduate teaching internship program will provide intensive teaching experiences for advanced graduate students in the biomedical sciences while generating release time for selected tribal college and baccalaureate college faculty to do other BRIN-related activities.
- An Administrative Core will provide overall project management and oversee program evaluation. It will also provide outreach and educational services through the sponsoring of grant-writing and bioinformatics workshops, enhancement of state-wide scientific conferences, and publication of newsletters and a website highlighting biomedical science in the state.

History

In October 2001, the National Institutes of Health (NIH) awarded 24 grants totaling $45 million to biomedical research institutions located in 23 states and Puerto Rico that have not fully participated in NIH grant funding in the past. The University of North Dakota School of Medicine and Health Sciences received a three-year, $6 million grant.

The awards, funded through the Institutional Development Award (IDeA) Program, enhance biomedical research capacity among academic institutions and research institutions within the states. The National Center for Research Resources (NCRR), the NIH component, administers the IDeA Program.

BRIN's Purpose

The grants enable each institution to establish a BRIN, a subcomponent of the IDeA Program. Through BRIN, the grantee institutions will develop areas of potential research through staff development and access to research resources. The program provides funding to:

- Bring together institutions within a state to establish the network;
- Make institutional alterations and renovations;
- Improve laboratory equipment; and
- Assist in the recruitment of new faculty.

Each BRIN program has unique characteristics depending on a state's infrastructure needs. However, the ultimate purpose of a network is to build an effective research base that will eventually lead to competitive research applications from multidisciplinary research teams.

BRIN's EPSCoR Roots

The IDeA program, established in 1993, is administered by the National Center for Research Resources (NCRR). The program's intent is similar to the National Science Foundation's (NSF) Experimental Program to Stimulate Competitive Research (EPSCoR). IDeA was designed to broaden the geographic distribution of NIH funding for health research. As authorized by Congress, the program's intent is to enhance the competitiveness for research funding of institutions located in 23 states and Puerto Rico with historically low aggregate success rates for grant applications to the NIH.

B R I N Symposium

MSU Interactive Video Network Studio

8:00 -- 10:00 am

Moderator: Dr. Katherine Sukalski, University of North Dakota

8:00-8:15 Heidi J. Super and Jessica D. Hamilton MOLECULAR ANALYSIS OF THE *MLL* LEUKEMIA GENE TRANSLOCATION BREAKPOINT REGION: BINDING OF NUCLEAR PROTEINS TO DISTINCT BREAKPOINT DNA FRAGMENTS

8:15-8:30 Brad Pederson, John R. Webster, and Ryan S. Winburn MINIMIZATION OF MICROABSORPTION EFFECTS IN COMPLEX MIXTURES

8:30-8:45 Christopher P. Keller EFFECT OF PETIOLE TREATMENT WITH THE AUXIN TRANSPORT INHIBITOR N-1-NAPHTHYLPHTHALAMIC ACID ON LEAF BLADE AUXIN CONCENRATION IN THE COMMON BEAN (*PHASEOLUS VULGARIS*)

8:45-9:00 Elizabeth Kiecker and Andre DeLorme SURVEY OF MICRO-CADDISFLIES (FAMILY HYDROPTILIDAE, ORDER TRICHOPTERA) IN MERCER COUNTY, NORTH DAKOTA AND A NEW SPECIES RECORD FOR THE STATE

9:15-9:30 Thomas P. Gonnella MULTI-CHANNEL ANALYSIS OF COMPLEX FLUORESCENT DYE MIXTURES - THE BEGINNING OF AN UNDERGRADUATE BIOMEDICAL RESEARCH PROGRAM AT MAYVILLE STATE UNIVERSITY

9:30-9:45 Katherine A. Sukalski, Donald P. Schwert, and John B. Shabb BIOMEDICAL RESEARCH CAPACITY BUILDING AT PREDOMINATELY UNDERGRADUATE INSTITUTIONS IN NORTH DAKOTA

9:45-10:30 Coffee Break

MOLECULAR ANALYSIS OF THE *MLL* LEUKEMIA GENE TRANSLOCATION BREAKPOINT REGION: BINDING OF NUCLEAR PROTEINS TO DISTINCT BREAKP0INT DNA FRAGMENTS

Heidi J. Super* and Jessica D. Hamilton
Department of Biology, Minot State University, Minot, ND 58707

Specific, non-random, reciprocal chromosome translocations are a common feature of leukemia cells and correlate with various subtypes of leukemia. These translocations, in which nonhomologous chromosomes exchange DNA sections, result in the repositioning of a gene (located at the chromosome breakpoint) at a foreign locus and in (1) aberrant expression of the gene or (2) expression of a novel from of the gene product. Either of these outcomes can initiate malignant transformation of cells and contribute to development of leukemia. The *MLL* gene, on the long arm of chromosome 11 (band q23,) is located at the chromosome breakpoint in translocations involving greater than 25 other chromosomal regions. In all cases studied, the 5' end of the *MLL* gene becomes fused to the 3' end of another gene, creating an oncogenic *MLL* fusion gene/ protein. The translocation breakpoint region in *MLL* is restricted to about 8000 bp (8kb) and contains exons 5-11 of the *MLL* gene. *MLL* translocations are a common feature of childhood and infant leukemias. In adults, *MLL* translocations are observed in both leukemia *de novo* and in leukemias that develop following treatment for a variety of primary tumors. These therapy-related leukemias follow treatment with inhibitors of the cellular enzyme topoisomerase II (topo II).

The limited size (8kb) of the *MLL* breakpoint region suggests that the mechanism of breakage and fusion involves specific DNA sequence or structure within the region. Although several in vitro studies have suggested the *MLL* breakpoint region is susceptible to cleavage by topo II, the region has not been analyzed with respect to direct binding of topo II or other proteins. We have used a standard gel mobility shift assay to determine if nuclear proteins normally bind the region. Using Polymerase Chain Reaction (PCR) we amplified three 200bp DNA fragments from the breakpoint region. Two fragments, probes A and C lie at the extreme 5' and 3' ends of the breakpoint region respectively; probe B overlaps *MLL* exon 9, near a proposed cleavage site for topo II. Briefly, Probes A, B, and C, which were labeled for chemiluminescent detection, were incubated with nuclear extract from a human leukemia cell line, REH, in separate reactions. Binding of nuclear proteins to individual probes was noted by retarded migration (shifting) of the probes during polyacrylamide gel electrophoresis.

Initial gel shift analysis indicates probe A specifically binds to one or more nuclear proteins from the REH cell line. In a modified "supershift" assay, in which we added a polyclonal antibody to topo II to the reaction, we note additional shifting of the probe, suggesting topo II is binding to probe A. Although we predicted that Probe B might bind topo II directly, at present we have not detected binding of nuclear proteins to either Probes B or C.

Although our studies are preliminary, we hypothesize that topo II may normally bind in the 5' *MLL* breakpoint region and in rare cases initiate double strand breaks which are not resealed. The chromosome breaks may initiate rearrangement with other chromosomes, resulting in *MLL* translocations. If confirmed, our studies will be the first to directly demonstrate topo II binding in the region in the absence topo II inhibiting drugs and show evidence of topo II binding in an unexpected region of the *MLL* breakpoint. Follow up studies will attempt to further pinpoint topo II binding sequences within Probe A.

MINIMIZATION OF MICROABSORPTION EFFECTS IN COMPLEX MIXTURES

Brad Pederson*, John R. Webster, and Ryan S. Winburn
Division of Science, Minot State University, Minot, ND 58707

In using X-ray diffraction (XRD) and the Rietveld method there are many factors that affect the results and the interpretation of the data that are collected. One problem that has historically plagued the accuracy of quantitative X-ray diffraction techniques is microabsorption, or more correctly, absorption contrast. Microabsorption has historically been accounted for using the Brindley correction or mainly ignored.

Mixtures containing materials that have been thoroughly characterized have been used to assess microabsorption effects under various conditions. The initial mixtures contain Cr_2O_3, ZnO, CeO_2 and SiO_2 These materials were used because of their well characterized properties, including crystallinity and particle size. The mixtures examined contained Fe_2O_3 (hematite), acetylsalicylic acid (aspirin, $C_9H_8O_4$), and acetaminophen ($C_8H_9NO_2$). The particle size of each material was determined using either a scanning electron microscope, SEM or X-ray disc particle sizer. The crystallinity of each material was determined by X-ray diffraction using either SRM 676 (alumina powder) as a primary standard or rutile as a secondary standard. The mixtures were mixed with three different internal standards (0.4μm TiO_2, 1.0μm TiO_2 and 2.2μm Al_2O_3) at a ratio 9/1 (0.90000g of sample mixture and 0.10000g of internal standard). Data were collected using a previously defined protocol by the authors using copper radiation. The data was examined using the Rietveld refinement method, and the results were then compared with and without the Brindley correction. The results should aid in the development of a better methodology for analyzing materials in more complex systems.

The particle size of each material is important for two reasons; first, larger particles show larger absorption contrast effects, and second, smaller particles are required for proper diffraction statistics. The mixing process may not only cause changes in the particle sizes, but also the structure or crystallinity of some phases (to be examined at a later date). If the change in particle size is not accounted for, the results from the pharmaceuticals mixtures showed a large error in when using the Brindley correction. This was seen when the phase's aspirin and acetaminophen phases were refined. Initial work on the SEM showed the particle size of aspirin to be 250 μm, minimal "mixing" in a mortar and pestle (5 minutes) decreased the particle size to 18 μm, while mixing the aspirin with rutile using a mortar and pestle resulted in a particle size closer to 5 μm. This decrease in particle size was also seen with acetaminophen, but was not as extreme. Suspicion of decrease in size should be taken into account when there is a large difference in the hardness of the phases used. The relative error percent in the linear absorption correction decreased along with the particle size from a value that was too large to be calculated (250 μm) in Bindley's work to –10.9% (5 μm) in a sample that contained hematite and rutile. The over-correcting not only affects the larger particles but the mixture as a whole. When the particle size is very large (100+μm) the linear absorption correction is not feasible.

EFFECT OF PETIOLE TREATMENT WITH THE AUXIN TRANSPORT INHIBITOR N-1-NAPHTHYLPHTHALAMIC ACID ON LEAF BLADE AUXIN CONCENRATION IN THE COMMON BEAN (*PHASEOLUS VULGARIS*).

Christopher P. Keller
Department of Biology, Minot State University, Minot, ND 58707

Plant growth and development is controlled by several classes of morphogenic hormones. Chief among these are the auxins (from the Greek for "to grow"). The principle naturally occurring auxin is indole acetic acid (IAA) which occurs ubiquitously in all plants. It is synthesized in leaves, especially young leaves. IAA is transported downward in the plant by a complex cell to cell mechanism that is sensitive to inhibition by N-1-naphthylphthalamic acid (NPA). Below the leaves, IAA has a controlling role in diverse aspects of development including stem elongation, tropisms, and generation of lateral roots. The role of IAA in the control of leaf growth was long thought to be limited. I have found, however, a developmentally sensitive electrical response by excised leaf strips from tobacco to the hormone and, more recently, have found that exogenous auxin applied directly to leaves results in the development of smaller leaves. This finding suggests IAA plays an inhibitory role in the development of the leaves in which it is synthesized. I also found that placing a band of lanolin containing NPA around the petiole of leaves also produced significantly smaller leaves.

This last experiment also suggests increased leaf auxin inhibits leaf growth if I assume that the NPA on the petiole, by inhibiting the movement of IAA out of the developing leaf results in an elevation of the level of the endogenous hormone in the treated leaf. That assumption is open to question, however. Others have recently reported that growing *Arabidopsis* seedlings on agar containing NPA resulted in plants with smaller leaves which were shown to contain lower levels of IAA. The researchers involved speculated that inhibition of auxin transport feeds back through some unknown mechanism to inhibit IAA synthesis. It is also possible in their experiment, however, that the inhibited root development resultant from NPA treatment causes poor leaf development as a consequence of poor nutrition. Poor nutrient status of the plant could then somehow down regulate IAA synthesis.

In July of 2002, I visited the lab of Jerry Cohen in the Department of Horticulture at the University of Minnesota where I measured the IAA content of NPA treated leaves and in the opposite control leaves using an established protocol. The protocol involved amino anion minicolumn and HPLC-based purification of IAA and quantification using gas chromatography-selected ion monitoring mass spectrographic analysis. As in previous experiments *Phaseolus vulgaris* L. var. Contender were grown under greenhouse conditions for 10-13 days. Plants with both monofoliate leaves having midribs 30-40 mm were selected for experimentation. The petiole of one monofoliate leaf on each plant was treated with 1.0 % NPA. One, 3, and 6 days following petiole treatment, treated and untreated leaves were harvested, weighed, frozen to -80°, and transported to Minnesota on dry ice. Individual leaves were then analyzed for IAA content.

I found that the IAA content was consistently higher in the NPA treated leaf on all three days, for example, averaging 53.2 ng IAA / g fr. wt. in the treated leaves compared to 29.3 ng IAA / g fr. wt. in the untreated leaves on day 1. The results support the assumption that auxin transport inhibition results in elevated auxin levels and supports the hypothesis that auxin inhibits leaf development.

SURVEY OF MICRO-CADDISFLIES (FAMILY HYDROPTILIDAE, ORDER TRICHOPTERA) IN MERCER COUNTY, NORTH DAKOTA AND A NEW SPECIES RECORD FOR THE STATE

Elizabeth Kiecker* and Andre DeLorme
Department of Biology, Valley City State University, Valley City, ND 58072

The purpose of this project was to collect and identify species of micro-caddisfly (family Hydroptilidae, order Trichoptera) found in central North Dakota. The caddisflies, or Trichoptera, are an insect order that have an aquatic larval and pupal stage and a winged, terrestrial adult stage. Species level identifications are based on the adult stage with larval stages being associated with the adults when possible. This leads to the larvae of many species being undescribed. Previous sampling in the Mercer County area, done in the summer of 2000, revealed micro-caddisfly larvae that current generic keys described as the genus *Metrichia.* This genus is known from Central America and the southwestern U.S. and was not known to exist in North Dakota. This means that this larval population is either far out of its range; an undescribed larva of a similar genus; or the larvae for a new, undescribed species. We preformed a survey of the three streams these larvae had been found in to try and determine which of these possibilities was correct and to document the micro-caddisfly fauna of this area.

On three dates in July and August, 2002, we sampled three different sites in Mercer County, near Beulah, North Dakota. The sites included Otter Creek, Brush Creek, and Coyote Creek. On the first sampling date we used a combination of D-frame kick nets and hand picking to collect aquatic Trichoptera larvae. On the second and third sampling dates we used the same methods to collect aquatic larvae, and also used a ultra-violet night collection lamp suspended behind a white fabric sheet to attract and collect winged adults. All the samples were returned to the Aquatic Macroinvertebrate lab at Valley City State University for identification.

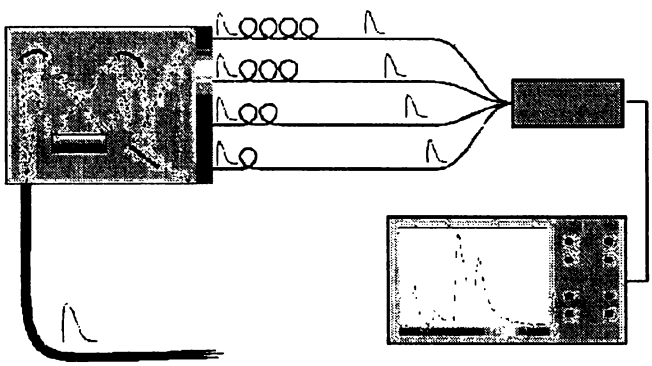
While the samples from our first date did not contain any of our unknown larvae, we did collect larvae of the micro-caddisfly genera *Hydroptila* and *Ithytrichia*. The genus *Ithytrichia* is a small genus with only two reported species, neither of which had been reported in North Dakota. There is no key to species for the larvae of this genus. Our second collection produced larval specimens of our unknown species as well as *Hydroptila* and *Ithytrichia*. The third collection resulted in specimens of adult *Ithytrichia clavata*.

While we were unable to collect the adults of our unknown micro-caddisfly larvae, we did collect additional larvae of this species, which demonstrate a remaining viable population. We will need to return next summer to attempt to collect the adults for positive identification. Discovery of both larvae and adults for *Ithytrichia clavata* does represent a new species record for the state.

MULTI-CHANNEL ANALYSIS OF COMPLEX FLUORESCENT DYE MIXTURES - THE BEGINNING OF AN UNDERGRADUATE BIOMEDICAL RESEARCH PROGRAM AT MAYVILLE STATE UNIVERSITY

Thomas P. Gonnella
Department of Chemistry, Mayville State University, Mayville, ND 58257

As a result of NIH funding through the BRIN program, an undergraduate research program has been initiated at Mayville State University. The focus of this undergraduate research is to use immerging technology to resolve complex fluorescent dye mixtures within biomedical applications. Through collaboration with Dakota Technologies, Inc. (DTI) of Fargo, our research group has been able to employ a two-dimensional collection technique that incorporates both spectral and temporal information. The ultimate goal of our research is to take advantage of this detection methodology to achieve gains in the accuracy and efficiency of DNA sequencing. The presentation will provide background information about the experimental setup (shown in part below), the current results, and future directions of research.



BIOMEDICAL RESEARCH CAPACITY BUILDING AT PREDOMINATELY UNDERGRADUATE INSTITUTIONS IN NORTH DAKOTA

Katherine A. Sukalski[1]*, Donald P. Schwert[2], and John B. Shabb[1]

[1]Department of Biochemistry and Molecular Biology, University of North Dakota School of Medicine and Health Sciences and the [2] Center for Science and Math Education, North Dakota State University

The aim of the North Dakota Biomedical Research Infrastructure Network (BRIN) is to build biomedical research capacity within the state. Increasing the number of students interested in careers in biomedical research will support this aim. Nine primarily undergraduate institutions (PUIs), including five tribal colleges and four public baccalaureate degree universities, participate in the North Dakota network.

The BRIN tribal college initiative to increase research capacity emphasizes the improvement of the science curricula available to Native American students with the purpose of improving their preparation and chances for success as they transfer to baccalaureate institutions. Technology plays the key role in leveraging the limited resources of faculty and expertise to create the foundation for improved science offerings, shared by all the tribal campuses. Support is provided to assist each tribal campus in preparing science laboratory facilities for Internet-based video-conferencing. A second effort is aimed at the development/adaptation of science curricula for IVN (Interactive Video Network) use.

The BRIN baccalaureate initiative to build research capacity emphasizes involvement of faculty and students in biomedical research opportunities on the four campuses. The individualized approaches that campuses are taking to meet this goal will be outlined. Several projects are common to all of the baccalaureate campuses. A Faculty Exchange Program is designed to foster interaction between students and faculty at baccalaureate institutions and biomedical researchers at UND and NDSU. Activities during an exchange include faculty meetings to explore collaborations, discussions of career options with students, and research-related presentations. The Graduate Teaching Internship Program brings science graduate student interns from the doctoral institutions to the PUIs to deliver course instruction and participate in other faculty activities for one semester. This provides release time for faculty at baccalaureate institutions to participate in research activities such as collaboration with UND/NDSU biomedical researchers and the development of more student-oriented research. An added benefit for students at the PUIs is the opportunity provided for them to interact with advanced graduate students who are actively engaged in their own research.

BRIN has made possible increased access to electronic resources at the PUIs. Access to 41 biomedical journals including Nature and Cell titles, and Vector NTI Nucleic Acid Analysis Software was provided to all sites within the first year. BRIN has sponsored workshops and meetings to foster networking between the institutions. This includes an IVN seminar series during the Spring semester of 2003.

This work was supported by the NCRR Biomedical Research Infrastructure Network grant 5P20RR016471.

A. Rodger Denison Student Research Competition

COMMUNICATIONS

UNDERGRADUATE

A. Rodger Denison Competition – Undergraduate Division [Part 1]
Minot State University Conference Center

Moderator: **Dr. Ronald K. Jyring**, Department of Biology, Bismarck State College

Judges: **Dr. Anna Grazul-Bilska**, President-Elect, North Dakota Academy of Science
Department of Animal and Range Science, North Dakota State University
Dr. Heidi Super, Department of Biology, Division of Science, Minot State University

10:30-10:45 Charles O. M. Strand, Richard R. Barkosky, and Christopher P. Keller EFFECT OF AUXIN TRANSPORT INHIBITOR N-1-NAPHTHYLPHTHALAMIC ACID ON PHOTOSYNTHESIS, STOMATAL CONDUCTANCE, AND INTERNAL CO_2 CONCENTRATION IN THE COMMON BEAN (*PHASEOLUS VULGARIS*)

10:45-11:00 Shonda Bretheim, Richard R. Barkosky, and Christopher P. Keller CHLOROPHYLL CONTENT OF COMMON BEAN PLANTS (*PHASEOLUS VULGARIS)* TREATED WITH N-1-NAPHTHYLPTHALMIC ACID (NPA)

11:00-11:15 Katherine M. Splichal, Shane M. Meyer and Garl K. Rieke THE AMYLOID BETA FRAGMENT ($A\beta_{1-42}$) IS AN INTRACELLULAR PROTEIN WITH A PROBABLE CAUSATIVE ROLE IN ALZHEIMER'S DISEASE

11:15-11:30 Kimberly Petry, Brittany Jablonski, Mary Lynn Johnson, Pawel Borowicz, Disha Pant, Justin Luther, Joan Beckman, Chainarong Navanukraw, Robert M. Weigl, Dale A. Redmer, Lawrence P. Reynolds and Anna T. Grazul-Bilska CELLULAR PROLIFERATION AND DENSITY DURING SKIN WOUND HEALING IN DIABETIC AND NONDIABETIC MICE

11:30-1:00 **Lunch [Annual Business Meeting]**

EFFECT OF AUXIN TRANSPORT INHIBITOR N-1-NAPHTHYLPHTHALAMIC ACID ON PHOTOSYNTHESIS, STOMATAL CONDUCTANCE , AND INTERNAL CO_2 CONCENTRATION IN THE COMMON BEAN (*PHASEOLUS VULGARIS*).

Charles O. M. Strand*, Richard R. Barkosky, and Christopher P. Keller
Department of Biology, Minot State University, Minot, ND 58707

Auxin (indole-3-acetic acid), a plant hormone is synthesized in the youngest leaves of the apical bud. Transported downward, auxin is known to have a role in controlling apical dominance, stem elongation, tropisms, and root development. Auxin may also play a role in leaf development. In earlier experiments, we increased auxin concentration in monofoliate bean leaves by either exogenous auxin application or by elevating the endogenous hormone level by applying the auxin transport inhibitor N-1-naphthylphthalamic acid (NPA) to the leaf petiole. In both types of experiments elevating leaf auxin concentration significantly inhibited leaf elongation, final leaf area, and final leaf weight. In other experiments, we found that smaller NPA treated leaves resulted from reduced leaf cell expansion (i.e., smaller leaf cells) rather than reduced cell division among leaf cells (i.e., fewer leaf cells). We also observed in our various experiments, that the smaller auxin treated leaves appeared darker green than untreated control leaves. We wondered if the darker treated leaves might also have altered photosynthetic activity. We hypothesized that if auxin-induced leaf cell growth inhibition resulted from water stress (i.e. a reduction in leaf water transport), photosynthesis would be depressed due to increased stomatal closure, alternatively, if auxin inhibited growth by other means, the greener leaves might have perform increased photosynthesis.

Intact uniform (4.25-5.25 g) seeds of *Phaseolus vulgaris* L. var. Contender were imbibed for 24 h on moist paper towels, and then planted individually in vermiculite. Seedlings grew and developed under typical greenhouse conditions. Ambient light intensity was supplemented to approximately 300 μg photons $m^{-2}s^{-1}$ with metal halide lamps (GLX 400WAgrosun, Hydrofarm Horticultural Products, Petaluma, CA. Temperature was maintained above 20ú and below 35ú C and plants were watered and fertilized weekly. Plants 9-13 days old with similar monofoliate leaves (both with midribs 30-40 mm) were selected for experimentation. The petiole of one monofoliate leaf on each plant was treated with either 0.5 % NPA in lanolin. After 7 d, the rate of photosynthesis (CO_2 untke), stomatal conductance, and internal carbon dioxide concentration (Ci) was determined on both the NPA-treated and untreated monofoliates using a Li-Cor portable photosynthesis system (Li-Cor Inc., Lincoln, NE). Leaf area was determined using CI-202 leaf area analyzer (CID Inc., Vancouver, WA).

Photosynthetic rate was significantly higher ($p<0.05$) in leaves attached to petioles treated with NPA when compared to the opposite untreated leaves. No significant difference was evident in stomatal conductance and Ci. NPA treated leaves were found to have lower dry weight than the opposite untreated leaf. The results do not suggest auxin-induced leaf growth inhibition is due to water stress.

CHLOROPHYLL CONTENT OF COMMON BEAN PLANTS (*PHASEOLUS VULGARIS*) TREATED WITH N-1-NAPHTHYLPTHALMIC ACID (NPA)

Shonda Bretheim*, Richard R. Barkosky, and Christopher P. Keller
Department of Biology, Minot State University, Minot, North Dakota 58707

Petiolar application of NPA, an auxin membrane transport inhibitor, increases the concentration of endogenous auxin in the bean leaf blade distal to the site of application. Leaves with NPA treated petioles grow more slowly than the opposite control leaves or leaves in other plants. Smaller NPA treated leaves apparently result from reduced leaf cell expansion (i.e., smaller leaf cells) rather than reduced cell division among leaf cells (i.e., fewer leaf cells). It has been observed that NPA treatment of leaf petioles results in darker green leaves. These same leaves have higher rates of net CO_2 uptake (as one measure of photosynthesis) than controls. However, conductance and internal carbon dioxide concentration were the same as controls (unpublished results), suggesting a biochemical basis for the change (e.g. more leaf chlorophyll molecules) in photosynthesis rather than disruption of plant-water relationships (e.g., stomatal closure). On the basis of these observations, we hypothesized that auxin-stimulated photosynthetic rate may result from an increase in leaf chlorophyll content in leaves attached to petioles treated with NPA.

Common bean (*Phaseolus vulgaris* L. var. Contender) seeds were germinated on moist paper and planted after 24 hr in vermiculite under greenhouse conditions. Ambient light intensity) was supplemented to approximately 300 μg photons $m^{-2}s^{-1}$ with metal halide lamps [GLX 400W Agrosun, Hydrofarm Horticultural Products, Petaluma, CA]. Temperature was maintained between 20ú and 35ú for the duration of the experiment. Plants were watered as needed and fertilized weekly. After 10-14 d, plants with similar monofoliate leaf size (approximately 3 cm-midrib length) were selected for further treatment and analysis. Lanolin containing 1.0 % NPA was applied in a band around one petiole of each bean plant. After a 7 d treatment period, acetone extraction of leaf chlorophyll was performed by grinding and filtering approximately 0.5 g of leaf material in acetone. Absorbance of chlorophyll a and b at 652 and 663 nm was determined by spectroscopy using a BioRad 3000 Smart-Spec uv/vis spectrophotometer. Chlorophyll content (mg chl $_{a\,or\,b}$/g fresh wt of leaf tissue) was expressed on a per weight of leaf tissue basis.

Chlorophyll a and b content in leaves treated with NPA were significantly higher ($p < 0.05$) than the chlorophyll concentrations of the opposite control leaf.

More chlorophyll could result in an increase in photosynthesis. The smaller cells of the NPA treated leaves may contain smaller vacuoles this would allow for greater density of chloroplasts in each cell.

THE AMYLOID BETA FRAGMENT ($A\beta_{1-42}$) IS AN INTRACELLULAR PROTEIN WITH A PROBABLE CAUSATIVE ROLE IN ALZHEIMER'S DISEASE

Katherine M. Splichal*, Shane M. Meyer and Garl K. Rieke
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Introduction

Alzheimer's disease (AD) is one of the most prevalent neurodegenerative diseases affecting the elderly population; therefore, it is imperative to find out what factors may be the cause. This form of senile dementia affects half of the population over the age of 85 and is projected to affect 14 million people by the year 2025 at an estimated cost of $840 billion dollars a year. From pathologic reviews, hallmarks of AD include extracellular plaques and intracellular neurofibrillary tangles in parts of the brain involved with cognition and memory. The tangles are composed of filaments of the microtubule-associated protein tau. The plaques are formed from the protein fragment known as the amyloid-beta protein (Aβ).

Aβ originates from the amyloid precursor protein (APP), which is synthesized in the rough endoplasmic reticulum (RER). APP is cleaved by various enzymes; the α, β, and γ secretases. Specifically, the β and γ secretases are significant in the production of Aβ fragments. The most important end protein fragments in AD are the 40 or 42 amino acid long peptides. The $A\beta_{42}$ fragment is thought to be the significant neurotoxic villain in AD. Research has shown that Aβ production and deposition in the form of fibrils leads to the death of specific populations of nerve cells in select areas of the human brain (cerebral cortex and hippocampus), eventually leading to the manifestations of AD, including memory loss, confusion, and disorientation among others.

Methods and Materials

Our research has focused on $A\beta_{42}$ and the mechanisms by which it intracellularly kills cells. This has included determining the membrane systems and organelles of cells where $A\beta_{42}$ is located and how the peptide may induce cell death. Rat hippocampi were challenged with 60μM chloroquine, which increases intracellular $A\beta_{42}$. $A\beta_{42}$ was localized to the endoplasmic reticulum (RER), nucleus and mitochondria. Light immunochemistry and electron microscopic immunogold was used to label antigens such as $A\beta_{42}$, the β and γ secretases involved in the genesis of $A\beta_{42}$, and the protein adducts of 4-hydroxynonenal (a lipid peroxidation product) to help visualize the membrane systems in which the antigens are located. Intracellular $A\beta_{42}$ has the opportunity to interact with various membrane systems, thereby triggering different cascades of events leading to nerve cell death and Alzheimer's disease.

Conclusion

The outcome of the research thus far has shown that the $A\beta_{42}$ fragment induces apoptosis and is found inside of the hippocampal pyramidal cells (on the RER, nucleus and mitochondria). The research is discovering possible mechanisms of how $A\beta_{42}$ kills these cells, whose loss in humans contributes to the profound memory

CELLULAR PROLIFERATION AND DENSITY DURING SKIN WOUND HEALING IN DIABETIC AND NONDIABETIC MICE

Kimberly Petry*, Brittany Jablonski, Mary Lynn Johnson, Pawel Borowicz, Disha Pant, Justin Luther, Joan Beckman, Chainarong Navanukraw, Robert M. Weigl, Dale A. Redmer, Lawrence P. Reynolds and Anna T. Grazul-Bilska
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During wound healing, an ordered sequence of events takes place that promotes the repair of injured tissues. Normal wound healing involves interactions between the extra-cellular matrix components, chemical mediators, and various cell types. Wound healing has three phases: inflammation (day 1 to 2 after injury), proliferation (approximately day 2 to 10 after injury), and maturation or remodeling (approximately day 11 to years after injury). In diabetes, there are multiple alterations in the local wound environment with abnormalities in all phases of wound healing. The purpose of this project was to determine the rates of cell proliferation and cellular density throughout the three phases of wound healing in the skin of diabetic and non-diabetic mice. Diabetic (n=30) and non-diabetic (n=29) mice were wounded and then sutured with 6-7 stitches. On days 1, 3, 5, 8, 14, and 21 after wounding, mice were sacrificed and weighed. Samples of blood and the entire wound were collected from each mouse. The wounded skin tissues were fixed in formalin for immunolocalization of proliferating cell nuclear antigen (PCNA). The number of proliferating cells and total number of cells in the non-wounded areas of the skin were determined using image analysis. Labeling index (%) was calculated as the number of PCNA-positive cells expressed as a percentage of the total number of cells, and cell density (%) was determined as the proportion of stained cells per area. Diabetic mice weighed more ($P<0.01$) and had higher ($P<0.01$) levels of glucose in their blood than non-diabetic mice (40.1 ± 0.6 vs. 20.5 ± 0.2 g and 567.3 ± 26.6 vs. 222.3 ± 8.0 mg/dL, respectively). For diabetic mice, the labeling index in the epidermis of the wounded area was similar on days 1, 3, 5 and 8 and increased ($P<0.05$) on day 14 and 21 after wounding. Labeling index in connective tissues of the wounded area increased ($P<0.05$) from day 1 to day 8 and then decreased. For non-diabetic mice, the labeling index in connective tissues and the epidermis of the wounded area was similar across all days of wound healing. For diabetic mice, the cell density in connective tissue of the wounded area increased ($P<0.05$) from day 1 to day 8 (0.9 ± 0.4 to 5.5 ± 0.8) and then decreased on day 14 (3.1 ± 0.5), and a similar level on day 21. For non-diabetic mice, cell density in connective tissue of the wounded area increased ($P<0.01$) from day 1 to day 5 (2.0 ± 0.3 to 6.2 ± 0.9) and then decreased on day 8 (2.8 ± 1.1), and remained at a similar level on days 14 and 21. These data demonstrate that cellular proliferation and/or cellular migration are delayed during wound healing in diabetic mice as compared to non-diabetic mice. *Supported by grants from NDSU Research Development Support Program and ND EPSCoR.*

A. Rodger Denison Student Research Competition

COMMUNICATIONS

UNDERGRADUATE and GRADUATE (Part 2)

A. Rodger Denison Competition – Undergraduate and Graduate Division [Part 2]
Minot State University Conference Center

Moderator: **Dr. Heidi Super**, Department of Biology, Division of Science, Minot State University

Judges: **Dr. Anna Grazul-Bilska**, President-Elect, North Dakota Academy of Science
Department of Animal and Range Science, North Dakota State University
Dr. Ronald K. Jyring, Department of Biology, Bismarck State College

1:00-1:15 Leslie L. Suchy, Christopher P. Keller, and Richard R. Barkosky HYDROQUINONE-INDUCED ROOT MEMBRANE HYPERPOLARIZATION IN *PHASEOLUS VULGARIS*: POSSIBLE MECHANISMS OF ALLELOPATHIC INTERFERENCE

1:15-1:30 Tyler C. Price and Christopher K. Beachy DRYING AND HIGH GROWTH DECREASE LARVAL PERIOD IN THE SPOTTED SALAMANDER, *AMBYSTOMA MACULATUM* (CAUDATA: AMBYSTOMATIDAE)

1:30-1:45 Joseph H. Hartman and Marron Bingle PRESERVATION OF UNDERREPRESENTED FRESHWATER MOLLUSKS IN THE UPPERMOST HELL CREEK FORMATION OF MONTANA

GRADUATE STUDENT PRESENTATION

1:45-2:00 Sandra M. Siegel and Patrick A. Carr A DEVELOPMENTAL PROFILE OF SSeCKS IMMUNOLABELING IN PRIMARY SENSORY NEURONS OF THE RAT

HYDROQUINONE-INDUCED ROOT MEMBRANE HYPERPOLARIZATION IN *PHASEOLUS VULGARIS*: POSSIBLE MECHANISMS OF ALLELOPATHIC INTERFERENCE

Leslie L. Suchy*, Christopher P. Keller, and Richard R. Barkosky
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Hydroquinone (HQ), a phenolic compound, is a widely recognized allelochemical. Allelochemicals are phytotoxic organic compounds released by one plant species that often negatively impact other plant species. Some plants readily detoxify HQ through glucosylation, yielding the monoglucoside arbutin. Research has shown that chronic exposure to HQ by leafy spurge (*Euphorbia esula* L.) disrupts plant-water relationships indicating the primary site of perturbation is in the root. One possibility is that HQ interacts with root cell membranes by disrupting membrane transport and this in turn leads to a breakdown mineral transport and ultimately water transport. Disruption of membrane transport would be evidenced by a change in the electrical-potential across the cell membrane (i.e., membrane potential). Any change in ionic fluxes across the membrane (i.e., a change in the activity of the plasma membrane proton pump, various ion channels, other transport proteins, or leakage directly across the phospholipid bilayer) will result in either a hyperpolarization (increasingly membrane potentials) or a depolarization (increasingly positive membrane potentials).

Here we report testing the hypothesis that the apparent toxicity of HQ to root cells results from disruption of membrane transport upon acute exposure to the chemical. In our experiments, we exposed bean roots with established steady electrical potentials to differing concentrations of HQ and arbutin for periods of several minutes and recorded changes in membrane potential.

Root tip sections measuring approximately 1 cm were taken from bean plants in the two leaf stage of development. They were placed in an incubation solution (1mM $CaCl_2$, 0.1 mM KCl, and 1.0 mM Mes/Btp pH 6.0) and allowed to equilibrate for 1-7 hr. Root tip sections were removed from the incubation solution and mounted on a Plexiglas stage using strands of thermostat. The mount was then placed in a perfusion chamber in which incubation medium flowed over the root tip at a rate of approximately 3.6 $mL \cdot min^{-1}$. A valve in the feed line allowed changing incubation medium composition. Membrane potentials were measured by impaling root cells with a conventional microelectrode connected to a high-impedance electrometer (Electro 705; WPI, Sarasota, FL) and digitally recorded (DUO18; WPI, Sarasota, FL). Successful impalings were indicated by a membrane potential at least as negative as -60 mV and close to unchanging for at least 10 min. After 10 min. of stable recording, the flow of incubation medium passing over the root tip was switched to include either HQ or arbutin. We exposed bean root tip sections to 0.25 mM, 0.1 mM, 0.03 mM HQ and 0.25 mM arbutin.

The membrane potential of the bean root tip cells exposed to 0.25 mM HQ hyperpolarized dramatically. The increased voltage developed steadily, leveling off after increasing about -70 mV at 15 min. in most recordings. At 0.1 mM, the hyperpolarization was approximately -30 mV stabilizing in 6-7 minutes. The corresponding concentrations of arbutin had no effect on the membrane potential. The HQ- induced hyperpolarizations were also found to be reversible upon returning the flow of incubation medium to HQ free solution resulted in repolarization. Our results support the possibility that toxicity of HQ on bean root tip cells might be mediated by an alteration of normal membrane transport.

DRYING AND HIGH GROWTH DECREASE LARVAL PERIOD IN THE SPOTTED SALAMANDER, *AMBYSTOMA MACULATUM* (CAUDATA: AMBYSTOMATIDAE)

Tyler C. Price* and Christopher K. Beachy
Department of Biology, Minot State University, Minot, ND 58707

Amphibian metamorphosis is thought to be affected by the conditions that larvae experience (e.g., food availability, temperature, pond drying). Wilbur and Collins (1973) proposed that all environmental variation can be transduced by detecting food availability via growth rate. For example, favorable conditions shoud lead to lengthy larval periods and deteriorating conditions should result in accelerated metamorphosis. We tested this now-classic model by subjecting *Ambystoma maculatum* to conditions of food changes and amount of water that is available during the larval stage. We hypothesized that larvae that were subject to a decrease in food and in water would be the first to metamorphose.

Eggs were obtained from a commercial distributor, placed in an aquarium, and checked daily for hatchlings. Each hatchling larva was placed in a shoebox with 2600 mL of water and assigned to a food and drying regime treatment group. A total of 160 larvae were used. 80 larvae were assigned to a low food regime and 80 were assigned to a high food regime. The larvae were kept under these conditions for 59 days whereupon we initiated a drying regime and a food switch. One-half of the animals were subjected to a food-switch. At the same date, one-half of the larvae in each food group were subjected to a drying regime. The drying regime consisted of a 100 mL reduction in water daily until only 400 mL remained in the shoebox. Larvae were weighed every 30 days and upon metamorphosis. We performed a full-factorial two-way MANOVA of length of the larval period and the mass at metamorphosis.

As intended, food regime resulted in variation in growth rates. Variation in growth rate affected metamorphic timing and size. Larvae on the high food regime metamorphosed earliest and at largest sizes. Larvae begun with low food that were switched had similar metamorphic mass but delayed metamorphosis compared to larvae with constant high food. Larvae on a constant low food diet had similar metamorphic mass and delayed metamorphosis compared to larvae that started with high food and were switched to low food. Larvae that experienced food switches metamorphosed at similar times. Larvae that were confronted with a reduction in water exhibited accelerated metamorphosis compared to those those experienced constant water volume. In addition, dried larvae metamorphosed at smaller sizes, presumably because of the correlated early metamorphosis prevented an extended growth period. The effects of food and drying regime were additive, suggesting that larvae can respond to these two pressures independently.

PRESERVATION OF UNDERREPRESENTED FRESHWATER MOLLUSKS IN THE UPPERMOST HELL CREEK FORMATION OF MONTANA

Joseph H. Hartman and Marron Bingle*
Department of Geology and Geological Engineering, University of North Dakota, Grand Forks, ND

Introduction. The end-Cretaceous Hell Creek Formation of eastern Montana and North Dakota is well known for its dinosaurs, but it also includes a diverse nonmarine molluscan fauna. The best know elements of the fauna are the freshwater mussels belonging to the family Unionidae (Class Bivalvia). Even with over 100 fossil localities already known, recent discoveries suggest an even more diverse molluscan fauna lived in association with the fluvially dominated environments of the Hell Creek Formation. In 2002, Rebecca Mattison (Wellesley College) discovered what seemed to be a typical unionid-dominated fossil assemblage. Quarrying, however, produced rare or otherwise unknown freshwater mollusks from the Hell Creek Formation. **Basic Data.** Fossil Locality L6701 is located in badlands of BigHorn Coulee (Peterson Point Quadrangle, sec 26, T. 22 N., R. 37 E.), Garfield County, Montana. The locality is about 70 m below the top of the Hell Creek Formation (~K/T). The 25-cm-thick shell-bearing interval consists primarily of clayey and very fine-grained sandy siltstone, with the dominant minerals being moganite (a quartz polymorph) and quartz. Some lithic stringers are more organic rich, with carbonized leaf and stem remains. Colors vary from light gray (N7) to yellowish gray (5Y 8/1). The shells are found randomly oriented with an admixture of sizes. **Method of Study**. With assistance of Sarah Uthus (North Dakota State University) and Dr. Mattison and her students, Lindsay DeRemer and Ruth Coffey, fossils were found individually through breaking relatively well-lithified matrix. No attempt was made to remove individual specimens from matrix in the field. About 200 kg of bulk matrix were processed by Joseph Preusser (UND) and Marron Bingle in the lab using dental tools and side clippers. Specimens were subsequently prepared under magnification. Remnant matrix was washed, screened, dried, and picked successfully for very small specimens. **Faunule.** This molluscan faunule is unusual primarily in its composition and taxon relative abundance. Relatively uncommon snails and clams include *Viviparus* and *Campeloma* (Viviparidae), *Lioplacodes* (Pleuroceridae), *Sphaerium* (Sphaeriidae), relatively uncommon and mostly unsculptured "*Unio,*" and less uncommon physids (Physidae). *Acroloxus* (Acroloxidae) and "*Hydrobia*" (Hydrobiidae) are relatively common, while the bivalve, an undescribed iridinid (Iridinidae), is rare. The faunule also includes minor dinosaur, turtle, gar, and other fish bones. **Interpretation.** The combination of previously unreported limpets, hydrobioids, and iridinids indicate a habitat not frequently sampled in Hell Creek or other Late Cretaceous aquatic environments. A limpet and hydrobioid were previously identified on the basis of poor material by Hartman in 1976 (from the Ryan Ranch Locality) several kilometers west of the present study. This occurrence permits the interpretation that, although seemingly extensive, sampling has missed certain quiet- or slack-water or lacustrine habitats in a fluvially dominated depositional system. The presence of physids and sphaeriids confirms quiet-water conditions. **Acknowledgments**. This research was supported by U.S. Department of Energy and UND's Energy & Environmental Research Center in a collaborative project with John Horner of the Museum of the Rockies. We appreciate the contribution of Richard Josephs and Shannon Heinle (UND) in the grain size and mineral determinations.

A DEVELOPMENTAL PROFILE OF SSECKS IMMUNOLABELING IN PRIMARY SENSORY NEURONS OF THE RAT

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Department of Anatomy and Cell Biology, University of North Dakota, Grand Forks, ND 58202

Abstract

SSeCKS (src suppressed C kinase substrate) is a proposed substrate for protein kinase C that has been localized in both the central and peripheral nervous system. We previously demonstrated SSeCKS immunolabeling in primary afferent terminals in lamina II of the rat spinal cord as well as within approximately 40% of small-diameter primary sensory neuron perikarya. Colocalization studies, along with results from rats treated neonatally with capsaicin, suggest that SSeCKS-containing neurons are unmyelinated C-, or small diameter myelinated Aδ-fibers that transmit nociceptive information. Developmentally, C- and Aδ-fibers differ in their growth patterns therefore we examined the developmental course of SSeCKS-containing fibers in the PNS and CNS of rat. Specifically, the distribution of SSeCKS immunofluorescence in representative sections of cerebellum, brainstem, spinal cord, and dorsal root ganglia was investigated in E17 to aged rats. In the spinal cord, labeling of primary sensory central axonal collaterals was present in the dorsal-most white matter at age E17 and, by adolescence, had extended ventrally, terminating in the dorsal portion of lamina II in the same pattern as seen in adult. Aged animals (2 years old) demonstrated a decrease in the apparent number of SSeCKS fibers in the dorsal horn. In the spinal ganglia, SSeCKS immunolabeling was present within most neuronal somata at E17 and, as development progressed, this ubiquitous SSeCKS distribution became restricted to small somata. In ganglia from aged animals, SSeCKS immunolabeling displayed a minor redistribution of the protein to the perinuclear region. These results suggest that SSeCKS follows the normal developmental pattern of unmyelinated primary afferents and, together with our previous studies, supports the hypothesis that SSeCKS is contained within a subclass of pain-transmitting primary afferents.

COMMUNICATIONS

PROFESSIONAL

NDAS SENIOR ACADEMY PROGRAM

Minot State University Conference Center

Moderator: **Anna Grazul-Bilska**, President-elect, North Dakota Academy of Science
Department of Animal & Range Science, North Dakota State University

2:00-2:15 Dwight E. Bergles and Van A. Doze NOREPINEPHRINE INHIBITS A SUBSET OF HIPPOCAMPAL INTERNEURONS

2:15-2:45 **Coffee Break**

2:45-3:00 Glenn I. Lykken, Berislav Momcilovic MYELIN FAT STORAGE OF ENVIRNOMENTAL RADON DAUGHTERS IN THE ETIOLOGY OF MULTIPLE SCLEROSIS – A NEW APPOACH

3:00-3:15 Douglas Munski STRUGGLES OF PRE-SERVICE EDUCATORS WITH FUNDAMENTAL TOPONYMIC LITERACY

3:15-3:30 William A. Siders and Henry C. Lukaski BODY, HALF-BODY, AND PRESENTING LIMB BONE-FREE, FAT-FREE WEIGHT: DETERMINATES OF VARIABILITY IN BIOELECTRICAL IMPEDANCE

3:30-3:45 Christopher K. Beachy and Travis Ryan TO HELL WITH METAMORPHOSIS: ON THE ECOLOGY AND EVOLUTION OF SIMPLE LIFE CYCLES IN THE AMPHIBIA

3:45-4:00 Sally J. Pyle, Patrick R. Stevens, and Katie E. Rau COCAINE DECREASES NEURITE ADHESION TO LAMININ AND INCREASES NEURITE LENGTH IN NGF TREATED PC12 CELLS

4:00-4:15 Jon Jackson SCIENCE AS A LANGUAGE — THE MORE YOU SPEAK IT, THE EASIER IT BECOMES TO UNDERSTAND: EXPERIENCES IN AN UNDERGRADUATE GROSS ANATOMY COURSE

6:00-6:30 Pre-Banquet Social Hour, Minot State University Ballroom

6:30-8:00 Dinner —
Mary Ann Sens, MD, Professor and Chair, Department of Pathology, University of North Dakota School of Medicine and Health Sciences

NOREPINEPHRINE INHIBITS A SUBSET OF HIPPOCAMPAL INTERNEURONS

[1]Dwight E. Bergles and [2]Van A. Doze*
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Norepinephrine (NE) has potent inhibitory effects in the hippocampus *in vivo*, consistent with our previous results indicating that NE depolarizes and increases the firing rate of GABAergic interneurons in this structure. However, whole-cell and cell-attached patch recordings from visualized CA1 interneurons in rat hippocampal slices revealed that NE was not uniformly excitatory, as it decreased the firing rate of a subset of hippocampal interneurons located in stratum lacunosum-moleculare. Whole-cell and cell-attached patch recordings were made from visualized CA1 interneurons and pyramidal cells in acute slices of rat hippocampus to investigate the modulatory effects of exogenous NE on GABAergic inhibition. NE at 10 μM reversibly decreased the firing frequency of a subset of hippocampal interneurons whose cell bodies were located primarily in stratum lacunosum-moleculare. This inhibition resulted from a direct hyperpolarization (~8 mV) that was accompanied by a decrease in input resistance. Interneurons that were hyperpolarized by NE had electrophysiological characteristics different from interneurons located in the same region that were depolarized by NE, exhibiting larger amplitude action potentials that were shorter in duration. Camera Lucida reconstruction of the morphology of biocytin-filled cells indicated that these interneurons had axonal arbors that were located primarily in stratum lacunosum-moleculare and stratum radiatum. Axon arborizations were rarely observed in the pyramidal cell layer. Slow voltage ramps (-130 to 20 mV) revealed that the outward current induced by NE reversed at the predicted equilibrium potential for potassium (K^+) ions and showed prominent inward rectification, suggesting that NE activates G protein-coupled inwardly rectifying K^+ channels (GIRK) channels in these interneurons.

The inhibitory effect of NE on these interneurons is mediated by an α adrenergic receptor (AR), as the effect of NE was mimicked by the α AR agonist 6-fluoronorepinephrine, but not the β AR agonist isoproterenol. The AR appears to be an α_2 subtype, as the selective α_2 AR agonists, α-methylnorepinephrine and oxymetazoline, similarly hyperpolarized these cells. In addition, the NE-induced hyperpolarization was inhibited by atipamezole, a selective α_2 AR antagonist, but not by YM-12617, a selective α_1 AR antagonist. The amplitude of pharmacologically isolated late inhibitory postsynaptic potentials (IPSPs) evoked in CA1 pyramidal neurons was reduced by NE. This effect also was blocked by atipamezole, a selective α_2 AR antagonist. In addition, this effect was occluded by prior application of the opioid, [D-Ala^2]-methionine-enkephalinamide (DALA), which hyperpolarizes interneurons, suggesting that the inhibition of the late IPSP by NE may result from the α_2 AR-mediated hyperpolarization of interneurons located in stratum lacunosum-moleculare. The inhibition of the late IPSP by NE caused a time-dependent increase in the excitability of CA1 pyramidal neurons by reducing the amplitude of the after-hyperpolarization following afferent stimulation.

MYELIN FAT STORAGE OF ENVIRNOMENTAL RADON DAUGHTERS IN THE ETIOLOGY OF MULTIPLE SCLEROSIS – A NEW APPOACH

Glenn I. Lykken, Berislav Momcilovic
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It is generally accepted that radon and its short-lived progeny account for approximately 50% of the total natural radiation dose to the world population. However, in dose calculations uptake of radon by fatty tissues and body organs is overlooked as attention is focused upon deposition of radioactive daughters in the bronchial tubes and the lungs. Indeed, it has been reported, but largely ignored, that inhaled radon is stored in lipids and produces varied physiological effects in the blood forming organs, the lymphatic tissue, the ductile glands, the liver, kidneys, and the brain. Moreover, radon solubility in fatty acids increases with the increasing number of carbon atoms such that the concentration buildup in body organ fat is about five times that of the inhaled radon concentration.

At the present, the possible role of the natural background radioactivity of radon and its daughters in the etiology of chronic human degenerative diseases such as multiple sclerosis (MS) is controversial. This disease occurs mostly in temperate latitudes of the western hemisphere; recently, a significant correlation between indoor radon concentration and MS occurrence has been reported in Norway. Furthermore, regions with high background radiation from radioactive fallout, or heavy downwind radiological discharges from nuclear weapon facilities, accompanied with relatively high indoor radon concentrations show evidence of high MS prevalence. It should be noted, that over the past 30 years, energy efficient homes have fewer air exchanges per hour resulting in greater radon concentrations and hence greater radiation doses.

Multiple sclerosis may be envisioned as chaos of the brain and spinal cord system produced when the fat- rich outer covering of nerve cells (myelin) is increasingly damaged and destroyed. The cause of MS has not been identified despite speculation that includes vitamin D, viruses and excess immune cells. Magnetic Resonance Imaging (MRI) has been used to identify lesions in the brain (frontal lobe) as a consequence of MS. Considering the above reported research data, we propose that stored radon in the fat rich myelin and the myelin-producing cells is able to damage myelin above the power of the cell damage repair mechanism. Some of the radon daughters decay by the emission of high energy alpha particles which can kill as many as two cells in their path; the damage which may be only increased in conjunction with other possible environmental factors such as viruses. Evidence for increased radon progeny in brain, myelin and nearby Oligodendrocytes could be found by measuring excess ^{210}Bi (beta) and ^{210}Po (alpha) emissions from MS affected brain and nerve tissues. The sensitivity of current radiation spectrometers makes these measurements possible.

STRUGGLES OF PRE-SERVICE EDUCATORS WITH FUNDAMENTAL TOPONYMIC LITERACY

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Fundamental toponymic literacy, i.e., the ability to identify and to locate place-names on a map, is an ongoing concern in preparation of teacher education majors in geography, social studies, and earth science at the University of North Dakota. While the ability to read and to interpret a map is only one dimension of the geographic skills and perspectives expected of students, it especially is crucial for K-12 teachers. Beginning with a University of North Dakota Office of Instructional Development Bush Scholarship of Teaching grant in 2001-02, highly formal assessment of student map reading and interpretation abilities slowly is being established

One measurement of student toponymic literacy is the International Geographical Union's World Basic Place Vocabulary Test (IGU WBPVT). Introduced in the late 1970s, it was superceded by Gallup Poll instruments favored by the National Geographic Society. Yet, it remains a useful device for introducing undergraduates to key concepts of toponymic literacy. The IGU WBPVT helps to promote the important ideas of being able: 1) to differentiate between land masses and water bodies; 2) to recognize a selection of the largest states in terms of area and in terms of population; and 3) to recognize major metropolitan centers on each continent excluding Antarctica. The test is predicated upon what is expected to be the level of understanding and comprehension of basic global toponyms for youth at age 13. Although it is being used in GEOG 151 (Human Geography), only the pre-test results of GEOG 419 (Methods and Materials of Geographic Education) for the Spring 2003 semester will be highlighted. Fourteen undergraduates took the pre-test in GEOG 419 in mid-January of 2003. There were four female seniors, seven male seniors, one female junior, and two male juniors. Considerably older than the target age of the IGU WBPVT, one would expect perfect or near perfect scores for each of the fifty items on the map assessment, especially considering some of these students already have taken GEOG 161 (World Regional Geography). Disappointingly, few perfect scores were obtained. Other preliminary results indicate the following: 1) that water bodies could be differentiated successfully from land masses even if the names of the water bodies were not correctly identified; 2) that European states were more frequently correctly identified than other parts of the world with the least well-known locations being African states; and 3) the selected metropolitan centers were not readily identified successfully.

Results for the post-test will not be obtained until early May of 2003, but in the interim, two different media are being used to help the undergraduates improve their toponymic literacy before they commence student teaching. Exercises are being used from a standard text, Building Geographic Literacy, in conjuction with a cd-rom, Geo-Tutor. The pre-service educators are discovering that knowing the fundamentals of location must be accepted as a pre-requisite ability if they are going to function successfully in dealing with more advanced topics and techniques of geography, including using GIS as an analytical tool. Truly, geographic education starts with location, location, location!

1. Geography Education Standards Project (1994) Geography for Life: National Geography Standards. Washington, D.C.: National Geographic Society, pp. 41-59.

BODY, HALF-BODY, AND PRESENTING LIMB BONE-FREE, FAT-FREE WEIGHT: DETERMINATES OF VARIABILITY IN BIOELECTRICAL IMPEDANCE

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The use of bioelectrical impedance analysis (BIA) to estimate body composition requires determining the impedance (Z, ohms) that the body offers to the conduction of an applied electrical current (alternating and low level). Fat and bone tissues are thought to be relatively high contributors to impedance and bone-free, fat-free (BFFF) tissues (which contain a large portion of the body's water and electrolytes) and are thought to contribute minimally to impedance (Lukaski, 1991). The purpose of this study was to determine whether the weight of the BFFF component of the body, half-body, or presenting limb accounted for more of the variability in the measured bioelectrical impedance.

Sixty-two women and 48 men were measured for whole body R and Xc at 50 kHz (RJL Systems Quantum X) and for body composition by pencil beam dual x-ray absorptiometry (Hologic, Inc. QDR 2000). Impedance was measured with a varying tetrapolar placement of electrodes on the right hand and foot (right side), the left hand and foot, on both hands (upper body), or on both feet. Right and left body were defined by a midsagital plane. Upper and lower body were differentiated with a transverse plane just superior to the crests of the ileum.

Participants ranged in age from 22 - 60 years with BFFF body from 29 - 79 kg and measured Z from 305 - 719 ohms. The mean of BFFF tissue was about equal for right-to-left and upper-to-lower body and for right-to-left arm and leg. Women averaged about two-thirds as much BFFF tissue as men in the trunk, 50% as much in the arms, and 60% as much in the legs.

The components of Z are resistance (R) and reactance (Xc): $Z^2 = R^2 + Xc^2$. Lukaski (2000) has reported that R represents more than 98% of the measured impedance of the body. Electrical conductor theory describes the relationship of impedance to conductor volume as $Z = \text{rho } L^2 / V$. We correlated the weight of BFFF tissue, containing the major portion of the body water, with R, the commonly considered index of body water and the major component of Z.

The coefficients (r) from correlating BFFF in the whole body, half body, presenting arm and presenting leg, with R when R was measured on the left side of the body were r = -0.830, -0.825, -0.796, and -0.823, respectively. When R was measured on the right side, r = -0.832, -0.838, -0.812, and -0.831, respectively. When R was measured across the upper body, r = -0.858, -0.862, -0.857, and 0.860, respectively. And when R was measured across the legs, r = -0.674, -0.683, -0.673, and -0.684, respectively.

The contribution of BFFF tissue to variability in R was not very different as a function presenting body segment source. The contribution of BFFF to variability in R was lower when R was measured across the legs. Foot-to-foot measurement of R may not be the method of choice for estimating body composition.

TO HELL WITH METAMORPHOSIS: ON THE ECOLOGY AND EVOLUTION OF SIMPLE LIFE CYCLES IN THE AMPHIBIA

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In a seminal paper published in 1973, Henry Wilbur and James Collins published a model of ecological control of metamorphic timing for amphibians. The paper has attained classic status: it is probably the most cited paper in the amphibian literature, and serves as the starting point for all those ecologists working on amphibian metamorphosis. Furthermore, their model has been used as the basis for attempting to understand the timing of various biological events, from arthropod metamorphosis to the onset of maturation in fishes to the timing of seedset in flowering plants.

Despite the ecological and evolutionary importance of metamorphosis and complex life cycles (CLCs) in the Amphibia, simple life cycles (SLCs) and the loss of metamorphosis have evolved repeatedly in frogs, caecilians, and salamanders. Understanding the evolution of SLCs from the ancestral CLC is an evolutionary problem requiring the integration of ecology, development, and physiology.

We examine experimental growth manipulations that have supposedly added support for the Wilbur-Collins model. While nearly every experiment that induced variation in growth rate resulted in variation in metamorphic timing, few of these studies actually support predictions of the model. Changes in growth rate early in larval period produce variation in metamorphic timing that isn't consistent with model while later changes often fail to produce any change in timing. This means that the Wilbur-Collins may be a useful heuristic tool for the development of testable hypothesis, yet it may lack adequate predictive capacity. A new paradigm is needed to understand how environmental signals can be transduced to an endocrinological result.

We present a survey of the taxonomic distribution the two types of SLC (paedomorphosis and direct development) in the Amphibia, review the life history theory and the ecological pressures that favor each types of SLC, and discuss the endocrine mechanisms that have been implicated thus far. We conclude with the suggestion of a simple model of the evolution of SLCs that considers both ultimate (evolutionary-ecological) and proximate (endocrinological-physiological) mechanisms to account for the loss of metamorphosis.

COCAINE DECREASES NEURITE ADHESION TO LAMININ AND INCREASES NEURITE LENGTH IN NGF TREATED PC12 CELLS

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The leisure use of cocaine increased drastically beginning in the 1980's, leading to an increase in the number of infants exposed to cocaine *in utero*. The incidence has been reported to be between 6 & 20%. Cocaine is lipid soluble, easily crosses the placental barrier and the fetal blood brain barrier and tends to be sequestered in the brain. Acute effects of cocaine exposure include fetal distress, seizures, irritable behavior, sleep disturbances, tremors and muscle rigidity. Congenital deficits in cognition, motor skills and attention have been reported after long-term follow-up of these infants. However, reports of congenital deficits are contradictory, probably due to confounding factors including differences in dose and timing of exposure and the use of other drugs in conjunction with cocaine. Therefore, it is important to develop models of *in utero* cocaine exposure that eliminate the confounding factors in order to understand the mechanisms of action of cocaine alone.

One animal model of *in utero* cocaine exposure has shown that cocaine alone, at doses that do not cause any acute effects, causes changes in the dendritic structure of pyramidal neurons in the anterior cingulate cortex of Dutch belted rabbits. The results of these studies indicate that cocaine leads to the formation of aberrant, serpentine dendrites that are approximately 30% longer than those seen in controls. The changes are only evident in the dendrites of dopaminergic neurons. These data indicate that cocaine interferes with pathfinding and outgrowth during neuronal development.

The purpose of the current study was to develop a cell culture model of cocaine-induced aberrant neurite growth and to examine whether cocaine interferes with pathfinding mechanisms. The PC12 cell line was chosen because when treated with nerve growth factor (NGF) these cells develop a neuronal phenotype similar to dopaminergic neurons. Neurites were 30% longer in PC12 cells, treated with 100 ng/ml NGF, and 1 ug/ml of cocaine, versus controls. Neurites from cocaine treated neurons developed an aberrant, serpentine growth pattern. Adhesion assays indicated that cocaine decreased adhesion of PC12 cells for the ECM. When these cells were grown in the presence of anti-laminin antibody, aberrant, serpentine neurites were observed. Western blotting indicated that integrin, a laminin binding protein, was not increased in cocaine treated PC12 cells. These data suggest that cocaine interferes with neurite pathfinding, in part, through changes in the binding of integrins to laminin in the extracellular matrix.

SCIENCE AS A LANGUAGE--THE MORE YOU SPEAK IT, THE EASIER IT BECOMES TO UNDERSTAND: EXPERIENCES IN AN UNDERGRADUATE GROSS ANATOMY COURSE

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We can all appreciate that the notion of how prior exposure to scientific subject material prepares one for learning the large and strange vocabulary of terms and concepts specific to scientific disciplines. Somewhat more surprising may be the notion that the previous exposure to science need not be discipline-specific; previous course work in other disciplines may also provide this preparation.

There are several possible explanations for this phenomenon, the laziest of which is that the students drawn to science are simply very intelligent and can handle the tasks that educators set before them. More likely however, is an explanation that considers the prior exposure to scientific terminology and ideas to have prepared students for both the rigor and expectations of science classes, and has also given them a basic framework on which to build new layers of terms and concepts.

I have been interested in understanding and developing classroom methodologies whereby the students with the least prior exposure to science can be given "tools" to most effectively master the large amount of strange words, ideas, and information – or if you will, the *language* – of the undergraduate gross anatomy course I teach each semester.

But is the premise really correct? In order to quantify this "language" effect, I have now inquired of each of the past three semesters worth of students as to how many courses in the natural and physical sciences they had taken. If prior exposure to science courses at either the high school or collegiate level is related to better performance in my undergraduate Human Anatomy course, I would expect students with the highest level of "fluency" in the scientific language to perform better than those with less of an exposure to this language. The data I have collected thus far appears to support this intuitive fundamental point.

In it's most simplistic state, mastery of scientific terms and concepts can be equated to the metaphor of becoming fluent in a language through immersion. At any rate, the measure of science exposure is a easily-measured variable that can be compared and correlated with performance on course exams and final grades.

Exposure of students to science in high school represents the first steps in their building a vocabulary necessary to achieve higher order understanding at the collegiate level. While this necessary first step seems intuitive, it also provides a rationale for aiding those students who are least prepared, but from whom high performance is expected nonetheless.

This research was supported by a Bush Teaching Scholars Fellowship.

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. *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. The student member dues shall be one-third (to nearest dollar) of the regular member dues. These dues are payable 1 December of each year.

Section 2. *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 3. *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 4. *Audit and Reports.* The Nominating Committee shall appoint on a yearly basis one member who is not a member of Council to conduct at least one internal audit per year. The Secretary-Treasurer shall report on the financial affairs of the Society, including the results of an annual audit, as may be requested by the Council.

BYLAW 3. *Membership*

Section 1. *Membership Categories.* Classes of membership shall include the following: (a) Regular, (b) Student, (c) Emeritus, (d) Honorary, (e) Supporting, (f) Sustaining, and (g) Lifetime Members.

Section 2. *Eligibility and Procedure for Membership.* Candidates for membership, except Sustaining Member, may be proposed by any regular or emeritus member of the Academy by submitting the candidate's name to the chairman of the Membership Committee.

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

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

(c) *Emeritus Members.* Any member in good standing upon formal retirement is eligible for emeritus membership. A majority vote of Council shall elect to emeritus membership.

(d) *Honorary Members.* The Academy may recognize, by awarding honorary membership, any person (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 nonpayment 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, an 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 of 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:

(1) Assist Council in carrying on the functions of the Academy including the receipt and disbursement of funds under the direction of Council.

(2) Manage the Academy Offices under Council's general supervision.

(3) Serve as Managing Editor of the *Proceedings of the North Dakota Academy of Science.*

(4) 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.

(5) Perform all other duties of the Secretary-Treasurer listed in the Bylaws.

(6) 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 which 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 of Office.* A President-Elect shall be elected annually by the membership and the following years shall succeed automatically to President and Past President to constitute a three year nonrenewable term. Three Councilors shall be elected by the membership to three-year, non-renewable terms on a rotating basis. All elected Council members shall take office at the end of the next annual Business Meeting following election and shall continue until relieved by their successors. Council is empowered to appoint and compensate a Secretary-Treasurer to successive three-year terms that commence with the beginning of the fiscal year.

Section 5. *Removal from office or position* If for any reason any elected member of Council is unable to fulfill his/her duties, the Council member may be removed from office by two-thirds vote of Council. If for any reason the Secretary-Treasurer is unable to fulfill his/her duties, the Secretary-Treasurer may be relieved of all duties by a majority vote of Council.

Section 6. *Interim vacancies.* Should a vacancy occur in the Presidency, the Council by a majority vote shall appoint a member of the Academy able to coordinate the next annual meeting to fill the unexpired term. A retiring interim President shall succeed automatically to Past President. Should a vacancy occur in the Presidency-elect, the Council shall reassess and change the location of the coinciding annual meeting as necessary and then call for a special election by mail ballot. An interim vacancy in the Past-Presidency shall be filled by the most recently retired Past-President able to fill the duties of the Past-President. Persons appointed to fill the unexpired term of Secretary-Treasurer are expected to remain in the position for a minimum of three years. A vacancy in the office of Councilor shall be filled by a majority vote of Council until the following election at which time the interim Councilor may stand for a full three year nonrenewable term.

BYLAW 6. *Committees*

Section 1. *Standing Committees.* Standing committees shall include but not be limited to, the following: Editorial, Education, Denison Award, Necrology, Nominating, Resolution, Membership, and Audit Committees. The President shall appoint members of committees other than the Nominating and Audit Committees.

Section 2. *Editorial Committee.* The Editorial Committee shall consist of three regular members appointed to three year terms. The duties are explained in BYLAW 7 (Publications).

Section 3. *Education Committee.* The Education Committee shall consist of five regular members and two high school teachers appointed to five year terms. The Education Committee shall work with high school students and teachers in the state, in visitation programs, Science Talent Search programs, and other programs to stimulate an interest in science by the youth of the state. It shall operate the Junior Academy of Science program and administer the AAAS high school research program.

Section 4. *Denison Awards Committee.* The Denison Awards Committee shall consist of six regular members appointed to three year terms. The Denison Awards Committee shall have as its prime duty the judging of student research and paper competitions, both undergraduate and graduate, and any other similar competitions. The committee shall also maintain the criteria to be used in the judging and selection of papers, such criteria to be circulated to prospective competitors.

Section 5. *Necrology Committee.* The Necrology Committee shall consist of three regular members appointed to three year terms. The Necrology Committee shall report to the annual meeting on those deceased during the preceding year. Obituaries may be included in the minutes of the annual meeting and/or published in the Proceedings.

Section 6. *Nominating Committee.* The Nominating Committee shall consist of the five most recent past-presidents. The major duties of the Nominating Committee are listed in BYLAW 5 (*Appointment, Nomination and Election of Members of Council*). The Nominating Committee will also administer the selection process, develop a separate funding source for a monetary award, and develop, for Executive Committee approval, the criteria for the North Dakota Academy of Science Achievement Award.

Section 7. *Resolution Committee.* The Resolution Committee shall consist of three regular members appointed to three year terms. The Resolution Committee shall prepare such resolutions of recognition and thanks as appropriate for the annual meeting. Further, the Committee shall receive suggested resolutions for the membership and transmit such resolutions and the Committee recommendation to the membership.

Section 8. *Membership Committee.* The Membership Committee shall consist of unlimited numbers of regular members appointed annually.

Section 9. *Audit Committee.* The Nominating Committee shall appoint on a yearly basis one member who is not a member of Council to conduct at least one internal audit per year.

Section 10. *State Science Advisory Committee.* The State Science Advisory Committee (SSAC) shall consist of five regular or emeritus members appointed to four year terms. The SSAC shall serve to direct questions of a scientific nature to the appropriate expert as requested, shall inform regional granting agencies and state and national science policymakers of its expertise and availability and shall counsel those agencies and persons upon their request. The SSAC shall adhere in particular to the guidelines described in Article V, Section 2 of the Constitution.

Section 11. *Ad hoc Committees.* The President may appoint such additional committees as may be needed to carry out the functions of the Academy. Ad hoc committees serve only during the tenure of the president who appointed them. Reports of ad hoc committees shall be presented to Council or to the annual meeting.

BYLAW 7. *Publications*

Section 1. *Editorial Committee.* Three regular members are appointed to the Editorial Committee for renewable three year terms. The Editorial Committee shall develop and recommend the Academy publication program and policies to the Council. It will assist the Editors of each official publication in reviewing manuscripts for those publications that include the *Proceedings* . Chairs of symposia will review manuscripts written for relevant symposia.

Section 2. *Managing Editor.* The Secretary-Treasurer shall serve as the Managing Editor of all Academy publications and as such shall oversee each Editor.

Section 3. *Editor.* Editors shall serve three year terms. The Editors shall edit all official publications of the Academy including the *Proceedings.*

BYLAW 8. *Memorial Fund*

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

BYLAW 9. *Fiscal Year*

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

BYLAW 10. *Achievement Award*

The Academy establishes the North Dakota Academy of Science Achievement Award to be given periodically to an Academy member in recognition of excellence in one or more of the following:

a. Nationally recognized scientific research.

b. Science education.

c. Service to the Academy in advancing its goals.

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

BYLAW 11. *Research Foundation*

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

(1) to receive funds from grants, gifts, bequests, and contributions from organizations and individuals, and

(2) to use the income solely for the making of grants in support of scientific research in the State of North Dakota.

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

The foundation shall be responsible for soliciting the funds for the purposes described. The Foundation funds shall be in the custody of the Secretary-Treasurer of the Academy and shall be separately accounted for annually.

The Foundation Board of Directors shall be comprised of five members of the Academy , representing different disciplines. Members shall be appointed by the President of staggered five year terms. The chairperson of the Board shall be

appointed annually by the President. The Board shall be responsible for developing operating procedures, guidelines for proposals, evaluation criteria, granting policies, monitoring procedures, and reporting requirements, all of which shall be submitted to the Executive Committee for ratification before implementation.

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

BYLAW 12. *Affiliations*

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

BYLAW 13. *Indemnification*

Section 1. Every member of the Council or employee of the North Dakota Academy of Science shall be indemnified by the Academy against all expenses and liabilities, including counsel fees, reasonably incurred or imposed upon him/her in connection with any proceedings to which he or she may be made part, or in which he or she may become involved, by reason of being or having been a member of the Council, or employee at the time such expenses are incurred, except in such cases wherein the member of the Council or employee is adjudged guilty of willful misfeasance or malfeasance in the performance of his or her duties. Provide, 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.

Minutes from last year's business meeting

Meeting was held in the Red River Valley Room of the UND Memorial Union. NDAS President Jody Rada and Secretary-Treasurer Jon Jackson presided.

Minutes from last year's meeting (available as a loose sheet) were approved.

Jr. Academy reports:
The Junior Academy met that morning (Friday) and had named 6 winners in its prize competition.

Senior Division		**Junior Division**	
1.	Megan Friskop, Hankinson	1.	Kurt Dahlstrom, Hillsboro
2.	Brian Fisher, Mandan	2.	Michael Ginsback, Hankinson
3.	Andrew Friskop, Hankinson	3.	Billy Casey, Hankinson

Margaret Nordlie – Judging chair – thanked the several graduate students from Biochemistry, Anatomy and Cell Biology and Microbiology who helped in the judging.

Announcements — from last evening:

Denison Competition:
Undergraduate
Winner: Erin Fox, GFHNRC
Runnersup: JoAnna Schmit, NDSU; Jennifer Larsen, Minot State

Graduate
Winner: Rhonda Schafer, UND
Runners-up: Justin Luther, NDSU; Clay Comstock, UND

The ***North Dakota Academy of Science Research Foundation*** announced grants being awarded to Dr. Richard Josephs, UND, Geology and Geological Engineering; and Dr. Andre Delorme, Valley City State, Biology.

Anna Grazul-Bilska (Animal & Range Science, NDSU) was elected by acclamation to the position of president-elect.

Chris Keller (Biology, Minot State) and Holly Brown-Borg (Physiology, UND) were elected by acclamation to serve three-year terms as councilors.

Life members Clark Markell and Allen Kihm made and seconded a motion, respectively to increase the amount of the Awards given to winners in the competition. After much discussion (and with several current and past student winners chiming in that perhaps a fancy plaque would be better), the motion passed. The amount available for winners was to be increased to $800, up from the current $400. With $200, 100, and 100 awards to be given in each of the undergraduate and graduate divisions respectively.

With discussion as to the dates and places of the next upcoming meetings, a March 27-28th date was set for 2003 in Minot, with plans to return the meeting to Fargo (President Grazul-Bilska) for 2004 and to Grand Forks (president-elect) in 2005. Kim Michelsen (Junior Academy) — noted that Junior Academy members prefer an April meeting date, and they may have to meet at a different time and location next year than the larger group.

There being no further business to conduct, President Rada thanked everyone for their participation and adjourned the meeting at 1:38 pm.

ACADEMY OFFICERS AND COMMITTEES - 2002-2003

Executive Committee
Membership:
- Past-President
- President
- President-Elect
- Secretary-Treasurer
- Councilors (three-year terms)

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President-Elect
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Executive Committee

Committees of the North Dakota Academy of Science

Editorial Committee*

Education Committee*

Denison Awards Committee*

Necrology Committee*

Nominating Committee

Resolution Committee*

Membership Committee*

North Dakota Research Foundation Board of Directors*

*** indicates available openings**

PAST PRESIDENTS AND LOCATIONS OF THE ANNUAL MEETING

NORTH DAKOTA ACADEMY of SCIENCE

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 Wheedon	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 Witmer	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 Clagett	Fargo
1955	G A Abbott	Grand Forks
1956	H B Hart	Jamestown
1957	W E Cornatzer	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 (elect)	Grand Forks
1993	John Brauner	Jamestown
1994	Glen Statler	Fargo
1995	Carolyn Godfread	Bismarck
1996	Eileen Starr	Valley City
1997	Curtiss Hunt	Grand Forks
1998	Allen Kihm	Minot
1999	Joseph Hartman	Grand Forks
2000	Mark Sheridan	Moorhead, MN
2001	Ron Jyring	Bismarck
2002	Jody Rada	Grand Forks
2003	Richard Barkosky	Minot
2004		Fargo

Contributors to the North Dakota Academy of Science Research Foundation

Virgil Carmichael (Bismarck)
James Dogger (Gore, VA)
Van A. Doze (Grand Forks)
J. Mark Erickson (Canton, NY)
Jon Jackson (Grand Forks)
W. Thomas Johnson (Grand Forks)
Glenn Lykken (Grand Forks)
Douglas Munski (Grand Forks)
William Siders (Grand Forks)
Armand Souby (San Marcos, TX)
Katherine Sukalski (Grand Forks)

Life Memberships

J. Mark Erickson (Canton, NY)
Douglas Munski (Grand Forks)
Robert Tarquinio (Los Angeles)

FINANCIAL STATEMENT
Summary of Accounts as of:

	12/31/2002
ASSETS	
Operating Accounts	
Checking	4466.48
Trust Accounts	
Scholarship	25958.48
Research Foundation	15450.19
Total	$45,875.15
LIABILITIES	
Advanced Dues Payments	
Restricted Purpose Funds	
Scholarship Principal	25958.48
Research Foundation	15450.19
Total	$41,408.67
Accumulated Surplus	$4466.48
Change in Surplus	1018.37
DUES	
Reinstatements	
Current year	1797.00
Future years	
Sponsor/Patron	
Total	$1797.00
INSTITUTIONAL SUPPORT	
NDUS TOTAL	$0.00
ANNUAL MEETING	
Registration fees	2677.50
Total	$2677.50
AWARDS PROGRAM	
Scholarship Dividends	850.26
NDAS Research Foundation	700.00
Total	$1550.26

as of 12/31/2002

PUBLICATION SALES	$243.00
MISCELLANEOUS INCOME	
Donations	200.21
Dividend Income	875.00
Total	$1075.21
TOTAL INCOME	$6,642.97

MEMBERSHIP	2002 estimates
Emeritus	ND
Students	12
Professional	77
Delinquent	100+
Dropped	30
Other	ND
Total Member Count	---

ANNUAL MEETING	
Speakers Expenses	0
Meals/Refreshments	2351.70
Printing	0
General Expenses	260.00
Registration refund	-
Total	$2,611.70

AWARD PROGRAMS	
ND Science/Engineering Fair	50.00
Denison	400.00
ND Junior Academy	350.00
Research Foundation Grant	700.00
Total	$1,500.00

PUBLICATION	
Proceedings	500.00
Supplement	
Total	$500.00

as of 12/312002

OFFICE EXPENSES	
Postage	186.55
Post Office Box Rental	39.00
Duplication	187.64
Supplies	500.00
Clerical Assistance	85.00
Phone	
Other	19.00
Bank Fees	83.30
Total	$1,100.49
MISCELLANEOUS	
Fidelity Bond	75.00
NAAS Dues	70.00
Other	10.00
Research Foundation Loan interest	
Total	$155.00
Total Disbursements	$5967.19
SCIENCE RESEARCH FOUNDATION	
CASH INCOME	
Donations from Members	0.00
Allocations from Dues	522.00
Interest Accrued	10.87
Sponsors/Patrons	
Total	$532.87
CASH EXPENSE	
Grants	700.00
Interest Compounding	
Other Disbursements	
Bank Fees	
Total	$700.00
Net Change	($167.13)
ASSETS	
Pass Book Savings, 31 Dec	4378.62
T-Note, book value	0.00
CD - note value	11071.57
Investment Total	$15,450.19
Change from previous year	$1606.54

as of 12/31/2002

SCHOLARSHIP FUND

CASH INCOME	
Sempra Energy	412.50
Alliant Energy	437.76
Total	$850.26
CASH EXPENSE	
Denison Awards	400.00
Junior Academy Awards	350.00
ND Science and Engineering Fair	50.00
Other Expenses	
TOTAL	$800.00
Net Change	$50.26

ASSETS		
Sempra Energy (purchased as ENOVA 1983, 250 shares)		
		902.68
Price	18.50	24.72
Value	4625.00	22314.13
IEC/Alliant Energy		
(purchased as IES Industries 1990, 120 shares)		
		218.88
Price	31.63	16.65
Value	3795.60	3644.35
Total Investment Value		$25,958.48
Change from previous year		($2,771.16)

Respectfully submitted,

Jon Jackson
Secretary-Treasurer,
NDAS

3/24/03

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