

2003

Abstracts for the 71st Annual Meeting

Follow this and additional works at: <https://digitalcommons.morris.umn.edu/jmas>

Recommended Citation

(2003). Abstracts for the 71st Annual Meeting. *Journal of the Minnesota Academy of Science, Vol. 67 No. 1*, 18-50.

Retrieved from <https://digitalcommons.morris.umn.edu/jmas/vol67/iss1/3>

This Article is brought to you for free and open access by the Journals at University of Minnesota Morris Digital Well. It has been accepted for inclusion in Journal of the Minnesota Academy of Science by an authorized editor of University of Minnesota Morris Digital Well. For more information, please contact skulann@morris.umn.edu.

ABSTRACTS

BIOINFORMATICS SYMPOSIUM

GRADUATE TRAINING IN BIOINFORMATICS AT THE UNIVERSITY OF MINNESOTA

Lynda B.M. Ellis

Graduate Program in Bioinformatics, University of Minnesota, Twin Cities

On February 8, 2002, the Regents of the University of Minnesota approved a new Graduate Program in Bioinformatics (URL = <http://www.binf.umn.edu/>). It offers Graduate Minors at the Masters and PhD level and includes 18 faculty members from 12 departments in 5 schools. On April 26, 2002 the Graduate Program held a daylong symposium with world-renown speakers, a poster session, and a lunch hosted by the Graduate Faculty. The symposium was presented to an overflow (100+) audience and was repeated in 2003. An informal Bioinformatics Journal Club met weekly in Spring 2002. It is now a formal class (BINF 5480) offered every Fall and Spring, starting with Fall 2002. A Bioinformatics email list, open to all, began in September 2001 and now has over 130 subscribers and receives over 30 posts a month. Nine students enrolled in the first year; several have already graduated with the minor. The Graduate Program's present curriculum, administration, and structure will be presented and plans for development will be outlined.

DATA EXPLORATION TOOLS FOR THE GENE ONTOLOGY (GO) DATABASE

Paulo Casaes, Edward Donkor, Lisa Lesnett, Gitch Onsongo, Erla Osk Petursdottir, Dennis Tkach, Elizabeth Shoop

Department of Computer Science, Macalester College

The GO Consortium is an effort to standardize nomenclature for genes and categorize gene products. This consortium has built a database containing genes and has placed them in three different categorization schemes, called ontologies. These ontologies are very large directed graphs. The amount of information in this database is huge, and current tools are unable to clearly display it. Additionally, existing tools do not enable users to perform particularly complex searches. In an effort to improve this situation, we built a 3-tier software system to clearly and interactively display the GO data and to perform complex queries against the database. Our system features reusable software components that can accommodate various future additions.

MINING PARTIAL PERIODIC PATTERNS IN CIRCADIAN RHYTHMS OF LOCOMOTOR ACTIVITY: A POTENTIAL SCREENING TOOL FOR ANALYSES OF COMPLEX BEHAVIOURS

Chih Lai, Graduate Programs in Software, and Dwight E. Nelson

Department of Biology, University of St. Thomas

In mammals a circadian pacemaker in the hypothalamic suprachiasmatic nucleus drives physiological and behavioral rhythms. Behavioral outputs from this pacemaker provide functional tools that have been invaluable for dissecting the molecular circadian mechanism. The circadian behavior that is most often studied in mammals is the activity/rest rhythm. In many rodents the rhythmic onset of locomotor activity is very robust and is used to measure the oscillator steady-state period and phase as well as resetting and entrainment of the oscillator by environmental signals. We are exploring the use of data mining techniques to find and quantify partial periodic patterns in mouse locomotor data. Using a genetic algorithm approach, we are attempting to detect partial periodic patterns of locomotor activity with periods and phase reference points found with conventional circadian analyses. Locomotor activity data was recorded from mice (C57BL/6J) entrained to light-dark cycles and in constant darkness to allow expression of endogenous circadian rhythms. We have also recorded activity from *mPer2^{brdml/+}* and *mPer2^{brdml/mPer2^{brdml}}* knockout mice that carry a mutation of the clock gene *mPeriod2*. This mutation induces a significant shortening of circadian period as well as more severe behavioral disruptions including arrhythmicity. Using analyses of circadian behavior as a model, we hope data mining techniques may extract more subtle behavioral patterns and partial periodic patterns that are invisible to conventional analysis methods. In the future, mining of behavioral data may provide useful screening tools for assessing the influences of genes, pharmaceutical agents or environmental signals upon complex animal behaviors.

THE BIOLOGY STUDENT WORKBENCH - BRINGING BIOINFORMATICS TO THE CLASSROOM, ENRICHING BIOLOGY EDUCATION

Kevin R. Messner

Bio-Medical and Magrath Libraries, University of Minnesota, Twin Cities

The Biology Student Workbench project (<http://bsw.ncsa.uiuc.edu/>), located primarily at the University of Illinois at Urbana-Champaign, provides training and curricular materials for biology teachers to include bioinformatics in their curricula. The project supports the Biology Workbench

(<http://workbench.sdsc.edu>)

and the Student Interface to the Biology Workbench (<http://bsw.ncsa.uiuc.edu/cgi-bin/sib.py>) as primary toolkits for investigation. The goals of the project are to 1) create a strong suite of tools usable by non-experts to conduct bioinformatics inquiries; 2) provide inquiry-based curricular materials for classroom use; and 3) establish a community of scientists and educators to support the use of computational research tools in education.

BUSINESS AND ECONOMICS SYMPOSIUM

HOW DOMINANT IS THE MALL OF AMERICA?

Kevin R. Knutson

University of St. Thomas, St. Paul, MN

The Mall of America is the largest shopping center among the Twin Cities' 10 retail centers and two downtowns. Its size, its large number of unique stores, and its diverse entertainment attractions help make it a prominent shopping venue for metro residents.

A mail survey was sent to 3,000 randomly selected households in the thirteen county Twin Cities metro area to determine 2002 holiday shopping preferences for malls and downtowns. A total of 437 surveys were received for an adjusted response rate of 14.7 percent. The survey asked which shopping areas consumers planned to shop at this holiday season and which they planned to shop most.

More people planned to shop at the Mall of America than any other retail area. The Mall draws most strongly from Southdale and the downtown St. Paul areas. It is much weaker in the areas served by downtown Minneapolis, Northtown and Rosedale. Most shoppers planned to spend most of their holiday dollars at the mall closest to where they live. The Mall's greatest draw is from Southdale and Ridgedale, while it loses the most shoppers to Southdale and Burnsville. Clearly, the Mall of America is the major retail force in the Twin Cities, but is not dominant. Thus, the Mall's ability to draw shoppers from outside the metro area is critical to its success.

THREE CONSECUTIVE DOWN MARKET YEARS: IMPLICATIONS FOR A RETIREMENT PORTFOLIO

James K. Kennedy, DBA,

Northern State University, Aberdeen, SD

The past three consecutive years of stock market declines suffered in 2000 to 2002 is an event not experienced by investors since the 1939 to 1941 war years. Indeed, each of the years 2000, 2001, and 2002 saw ever increasing declines in two of the major market indices. Specifically, the Dow-Jones fell 6.2 percent in 2000, 7.1 percent in 2001, and 16.8 percent in 2002. Similarly, the broader based Standard & Poors 500 dropped 10.1 percent, 13.0 percent, and 23.4

percent, respectively, in each of 2000, 2001, and 2002. Worst of all three, the technology heavy NASDAQ plummeted 39.3 percent, 21.1 percent, and 31.5 percent over the three years noted. Such losses were especially devastating for retirees or near retirees accustomed to the approximately 20 percent gains enjoyed over five consecutive years during the previous, also unprecedented, 1995 to 1999 period. The current study revisits an earlier work where various retirement portfolios were analyzed for their ability to: 1) provide current income, 2) protect against inflation, and 3) preserve portfolio value. This latest model has abandoned the third objective and focused on whether a hypothetical portfolio can reasonably sustain a retiree over a lengthy retirement period without premature depletion. Retirees are still advised to place some portion of their portfolio in "value" stocks to protect against inflation over what may be a twenty to thirty year retirement period. However, a strong base of fixed return investments is also recommended to weather a prolonged market downturn.

ON EXPORT-ORIENTED GROWTH STRATEGIES: AN ECONOMETRIC ANALYSIS

Kyle Haemig

St. Olaf College, Northfield, MN

This paper does two things: First, it adds to the literature on exports and growth causality; and second, it attempts to get a rough idea on whether there exist linkages in industrialized countries that could transmit a trade shock to the rest of the economy. We analyze quarterly data from the US, Britain, and Australia, and find that, at least in these countries, growth-led exports (GLE) is at least as valid a hypothesis as export-led growth (ELG); and that the success of an outward-oriented trade strategy (OTS) is dependent upon the country itself, and is by our measures not always feasible.

VALIDATING THE MEDIAN POLISH MODEL USED TO ESTIMATE RETAIL SALES SUPPRESSED BY THE CENSUS

Lorman L. Lundsten and David P. Brennan

University of St. Thomas, St. Paul, MN

Retail sales data provided by the Census Bureau is increasingly incomplete because of the disclosure rule prohibiting release of data that would reveal sales for individual establishments. Suppressed sales at the county level in Minnesota grew from 1.5% in 1948 to 28.8% in 1997. The problem is most acute for sparsely populated counties and for miscellaneous and general merchandise sales categories, which had over 65% of their sales suppressed. The problem is the result of the rapid decline in the number of establishments and the rapid increase in the number of general merchandise discount stores.

The exploratory data technique, median polish, was used to estimate retail sales in a category as a function of the general importance of the category and the importance of the county in all retail categories. One key concern with this method is that there is no formal statistic indicating goodness of fit of the model. To get an indication of the explanatory power of the technique, approximately ten percent of the data values for Minnesota were held out and the model was fit. The coefficients determined in this process were used to estimate the missing values. The estimates were then correlated with the withheld values. The estimated values explained 89% of the variance in the known values that had not been used to calibrate the model.

In the next phases of this project, data from several states will be used to determine the stability of the coefficients used to make the estimates and to make an overall judgment on the model's applicability in retail data analysis tasks like trade area estimation.

EXPECTATIONAL SHOCKS: WHAT IS THEIR IMPACT ON THE MACROECONOMY AND TO WHAT EXTENT HAS IT DIMINISHED DURING THE "NEW ECONOMY"?

George Veletsianos

Macalester College, St. Paul, MN

Using data for the US economy for the period 1973-2001, this study empirically tests the impact of expectational shocks on output before and after the "New Economy". The set of models characterized by strategic complementarity predict that announcements of revisions of economic variables should be positively correlated with future output. Assuming that revisions of macroeconomic variables represent expectational shocks to economic agents, I hypothesize a positive correlation between shocks and output. I show that, consistent with previous research that provided numerical bounds, expectational shocks may account for up to 12 percent of output variability. This paper adds to the existing literature by testing whether the emergence of the "New Economy" has reduced the effects of expectational shocks on output. Theory suggests that this impact may weaken given a structural change in the economy. Thus, to the extent that the "New Economy" reduces the responsiveness of economic agents to shocks, the impact of expectational shocks should diminish. My findings provide statistically insignificant evidence to support my hypothesis. Yet, the topic of the "New Economy" per se is controversial enough to warrant more research.

U.S. FARM SUBSIDIES AND RICE PRODUCTION IN COSTA RICA

Rebecca P. Judge, Ph.D., Anthony D. Becker, Ph.D.,
Bidisha Bhattacharyya

St. Olaf College, Northfield, MN

In this paper we examine the effects of world prices, and by extension, U.S. farm subsidies, on rice production in Costa Rica. Critics of U.S. farm policy contend that high subsidies to U.S. farmers allow exports of commodities that would not otherwise be competitive on the world market. This causes significantly lower international agricultural commodity prices reducing incomes for farmers in developing nations and exacerbating agrarian poverty. Additionally, these distorted prices cause changes in developing nations' land uses and interfere with attempts at food self-sufficiency. Adding to these nations' difficulties are WTO limits on a nation's ability to protect domestic agriculture through tariffs or import quotas. In the case of Costa Rica, the domestic rice market includes a system of price supports and controls as well as some import barriers. The stated purposes of these programs are to insure self-sufficiency in rice production, protect the incomes of farmers, and provide a staple food item to the public at a reasonable price. We estimate the internal cost of this program in light of the falling world price of rice and estimate the effect of world prices on domestic production. We find that while falling world rice prices have had little effect on Costa Rican rice production, they have caused the price support program to become increasingly costly and potentially untenable.

ENRON RECESSIONS – ENERGY PRICE SPIKES AND THE U.S. ECONOMY

D. Becker, Ph.D., Rebecca P. Judge, Ph.D Anisa
Xhafka

St. Olaf College, Northfield, MN

Wholesale energy prices, particularly for electricity and natural gas, began rising in late 2000 and spiked in 2001 causing high utility costs for businesses and consumers and resulting in the bankruptcies of major public utilities. Like the oil price shocks of the 1970's, we show that these energy price spikes resulted in a significant reduction in aggregate macroeconomic activity and are a primary factor in the current economic slowdown. We determine the effect on GDP of the energy price spike by using a vector autoregressive forecasting model for key macroeconomic aggregates of the U.S. economy. By generating forecasts with and without the spike in energy prices we are able to estimate the net effect of the price spike. We find that, absent the rise in energy prices, the U.S. economy would have experienced a slowing of growth but would probably not have fallen into recession in 2001. Similarly, we predict that the current rise in energy prices is likely to delay any macroeconomic recovery.

GLOBALIZATION AND ITS ADVERSE EFFECTS ON DEVELOPING COUNTRIES

P. Diana Ponraja

The College of St. Catherine, St. Paul, MN

In the course of history, less than thirty nations have become rich and more than eighty percent of the world's population lives in middle and low-income countries, some of them in poverty (Kolodko, Abstract). But what does this mean? The spread of economic globalization has accounted for increased openness of an economy to foreign trade thereby allowing the country to partake of the many advantages of globalization. But what exactly is globalization? [Globalization] is a term that has been widely used in many contexts and with many meanings. Economic globalization relates to the high degree of economic interdependence that exists between most, if not all, countries in the world. Economic interdependence refers to the integration of all aspects of a nation's economy, which include its industries, service sectors, levels of income and employment and living standards that are all linked to the economies of its trading partners. This linkage takes the form of international movements of goods and services, labor, business enterprise, investment funds and technology (Carbaugh, p.3). This paper hopes to answer the question of why globalization may not be the best answer to rapid economic growth for developing countries. This paper begins by informing the reader about what globalization entails. It goes on to expand on the reasons why globalization does not work for developing countries as explained through the weaknesses of the five main claims of globalization outlined by Manfred B. Steger, author of "The New Market Ideology: Globalism". The first claim is that globalization is about the liberalization and global integration of markets; the second is that globalization is inevitable and irresistible; the third claim is that nobody is in charge of globalization; the fourth is that globalization benefits everyone; and the fifth claim is that globalization furthers the spread of democracy in the world. During the course of this paper, the limitations of these arguments will be examined in detail showing that the factors present in developing countries are not conducive to the adoption of globalization in these countries. They are too young, economically fragile, and lack the required political system and sound economic base and infrastructure to be successful participants in the globalization phenomenon. Although globalization is supposed to ensure economic growth and incredible financial gains for its participants, globalization may, in fact, serve to cement the polarization between the rich and poor. The economies of many countries in the developing world remain extremely vulnerable to domestic and external shocks, and they seem unable to cash in on the increased internationalization of the world economy

because they do not have the quality or quantity of economic resources available to developed countries to tackle economic problems (Murshed, p.2). Moreover, developed countries that have already embraced globalization, adopt trade protectionist measures like tariffs and grant subsidies to inefficient domestic producers in order to protect them from more cost effective and competitive foreign producers. Such measures have not advanced the cause of globalization and have led to the enhancement of its negative effects like drain of human capital, increase in unemployment rates, shrinking of the size of the middle class and its workers, decrease in environmental standards in developing countries etc. Developed countries also hold better terms-of-trade advantages over their developing counterparts and this influences the course and formulation of globalization and international trade strategies, thereby piloting globalization towards a path set by developed countries. Such arguments will be explored in depth in the following sections of this paper and based on the compelling evidence presented for such lines of reasoning, the reader will come to the conclusion that globalization does have adverse effects on developing countries and is not necessarily the answer to their economic and financial prayers.

CONSTRUCTING DEMOGRAPHIC PROFILES WITH GIS

Robert J. Werner

University of St. Thomas, St. Paul, MN

This paper will demonstrate how the techniques of Geographic Information Systems (GIS) are used to construct demographic profiles. Such profiles are useful for store- and service-location problems, marketing and advertising, determination of trade areas, and related questions. The client for this project is a successful gift store in St. Paul. They have four stores and are considering opening a fifth. The problem is to construct and compare the demography of the existing stores, then use the resultant demographic profile around the two most successful stores to evaluate the location of the new store. The GIS solution involves 12 separate procedures. All of these procedures will be demonstrated, using the GIS software ArcView. The intent of this paper is to both show what the logic of the solution is, and demonstrate the steps of processing. The audience member should emerge from this talk with an understanding of how demographic profiles are constructed with GIS, as well as an idea of the look and feel of how individual GIS procedures are executed with the software.

The following abstract was erroneously left out of the 2002 Annual Meeting abstract issue.

A CRUDE ANALYSIS OF REGIONAL POLICY WITH REFERENCES TO NORWAY

Steven Soderlind

St. Olaf College, Northfield, MN

This presentation applies Nash's model of cooperative agreement to policies that distribute a state's or nation's income more evenly across far-reaching settlements. The model highlights a tendency of such policies to escalate in strategic, highly visible stages, and to evolve with changing development prospects and consumer location priorities. The case of Norway's Regional Policy is used to exemplify the main points of discussion.

BUSINESS ETHICS: REVISITING THE ROOTS OF AN AGE OLD PROBLEM

Richard J. Rexeisen

University of St. Thomas, 2115 Summit Ave, St. Paul, Minnesota, 55105

The recent filing for bankruptcy by Enron has once more focused national attention on the ethical practices of our business leaders. The purpose of this paper is suggest that one of the contributing factors to the difficulty in implementing good ethical practices may be grounded in the formative educational experience that our managers receive at our institutions of higher learning. Retracing the history of ethical thought from the Hellenistic period (3rd and 4th centuries BC), it will be argued that an unintended outcome of grounding ethics in the classic western philosophic tradition (e.g., Plato and Aristotle) has been to create an artificial and dysfunction divide between ethics as a reflective exercise and business practice as an activity. Central to this thesis is whether or not how we frame our understanding of ethics will have an impact on how we behave as an ethical person. As a general rule, or opening proposition, it will be argued that our perception of reality influences how we define our problems and opportunities. How a problem is defined predisposes us to a set of alternatives and eventually an acceptable solution (or set of future actions). It will argued that the world of work has been set apart from introspective reflection, or if you prefer we have separated the world of values from that of enacted behavior, in such a way that we make behaving ethically a disjointed and needlessly laborious task.

ENVIRONMENTAL HEALTH IN THE 21ST CENTURY SYMPOSIUM

QSAR MODELS OF THE IN VITRO ESTROGEN ACTIVITY OF BISPHENOL A ANALOGS

Coleman, K.P., Toscano, W. A., Jr., Wiese, T. E.
Environment and Occupation Health, University of Minnesota, Twin Cities

Bisphenol A is a monomer constituent of epoxy and polycarbonate resins used in consumer and healthcare products. Many studies have shown that bisphenol A is a weak estrogen receptor agonist with endocrine disrupting potential in exposed organisms. Presented here are a series of quantitative structure activity relationship models to describe the in vitro hormone activity (estrogen receptor binding, reporter gene induction, and cell proliferation) of bisphenol A and 24 of its analogs. The hormone activity ranged over four orders of magnitude, with bisphenol A displaying intermediate activity. Comparative molecular field analysis, comparative molecular similarity indices, and hologram quantitative structure activity models were generated using SYBYL 6.9. Bisphenols with optimal estrogen activity contained two unencumbered phenolic groups in the para orientation, and multiple alkyl substituents extending from the ring-linking carbon. Bisphenols with methyl group hydrogens replaced by halogens also produced strong estrogenic analogs. These studies suggest that it may be possible to use structure activity models to develop bisphenols that are useful monomers with reduced hormone activity.

SENSING AND RESPONDING TO ENVIRONMENTAL SIGNALS: THE REGULATION OF EXTRACELLULAR SIGNAL-REGULATED KINASE BY PALYTOXIN

Janel K. Warmka and Elizabeth V. Wattenberg
Division of Environmental and Occupational Health, University of Minnesota School of Public Health, Minneapolis, MN

Humans are exposed to many substances in the environment. These substances have the potential to exploit signaling pathways that regulate cell fate and function and cause disease. This research is focused on determining how two model carcinogens, palytoxin and TPA, modulate cell signaling pathways. We have discovered that palytoxin and TPA modulate a common target, extracellular signal-regulate kinase (ERK). However, palytoxin and TPA appear to activate ERK using different mechanisms. In addition, palytoxin is only able to activate ERK in cell lines containing the activated ras oncogene. Our goal is to use basic research to reveal fundamental causes of disease, leading to innovative prevention strategies.

DETECTION AND QUANTIFICATION OF PERFLUORINATED SURFACTANTS IN GREAT LAKES FISH

Kelly Dorweiler, Matt Simcik

Division of Environmental and Occupational Health, University of Minnesota School of Public Health, Minneapolis, MN

Perfluorinated surfactants are a chemical class of emerging concern in environmental chemistry. These compounds are extremely persistent, and in the case of perfluorooctane sulfonate have been found in wildlife around the globe. While perfluorinated surfactants have been around for quite some time, only recently have analytical techniques been developed to adequately quantify these compounds in environmental samples. The instrumentation of choice to date has been liquid chromatography with triple quadrupole mass spectrometry (LC/MS/MS). These instruments are quite expensive, and so we have developed a method for perfluorochemical analysis using liquid chromatography with single quadrupole mass spectrometry (LC/MS). We will present our analysis technique and results from our analysis of Great Lakes fish.

PAIRING GENOTYPE WITH PHENOTYPE: DO VARIANT O6-ALKYLGUANINE-DNA ALKYLTRANSFERASES HAVE DIFFERENT O6-[4-OXO-4-(3-PYRIDYL)BUTYL]GUANINE REPAIR PHENOTYPE

Renée S. Mijal^{1,2}, Nicole M. Thomson³, Anthony E. Pegg⁴, and Lisa A. Peterson^{1,3}

¹*Environmental Toxicology and* ²*Environmental Epidemiology Programs Division of Environmental and Occupational Health,* ³*Cancer Center, University of Minnesota School of Public Health, Minneapolis, MN,* ⁴*Pennsylvania State University School of Medicine, Hershel, PA*

4-(Methylnitrosamine)-1-(3-pyridyl)-1-butanone (NNK), a compound found in tobacco products, is a potent pulmonary carcinogen in rodents and a likely human carcinogen. NNK both methylates and pyridyloxobutylates DNA, forming [O6]-methylguanine ([O6]-mG) and [O6]-[4-oxo-4-(3-pyridyl)butyl]guanine ([O6]-pobG), in addition to other adducts. Both of these O6-alkylguanine adducts are mutagenic. They are repaired by [O6]-alkylguanine-DNA alkyltransferase (AGT). The mutagenicity of these [O6]-alkylguanine adducts in human cells is enhanced when AGT is depleted. Individuals unable to repair [O6]-alkylguanine adducts may be at increased risk of developing lung cancer. Several variants of human AGT have been identified and there may be functional differences between these variants. One phenotypic variation may involve differences in ability to repair small versus bulky [O6]-alkylguanine adducts. Several human AGT variants were assessed for repair preference when presented with equal molar amounts

of oligonucleotides containing site-specifically incorporated [O6]-mG or [O6]-pobG adducts. Relative adduct repair rates were measured by either HPLC or a gel-based assay. Both wild-type and I143V/K178R displayed a similar 2-3 fold preference for the repair of O6-mG over O6-pobG in single stranded DNA. The gel-based assay will be employed to phenotype human livers for their ability to bulky [O6]-alkylguanine adducts. The overall goal of this research is to test the relationship between AGT phenotypes and lung cancer risk in populations exposed to tobacco smoke.

QSAR MODELS OF THE IN VITRO ESTROGEN ACTIVITY OF BISPHENOL A ANALOGS

Coleman, K.P.¹, Toscano, W. A.¹, Jr., Wiese, T. E.²

¹*Environmental Toxicology Program Division of Environmental and Occupational Health, University of Minnesota School of Public Health, Minneapolis, MN,* ²*Environmental Health Sciences Tulane School of Public Health and Tropical Medicine and Center for Bioenvironmental Research at Tulane and Xavier University, New Orleans, LA*

Bisphenol A is a monomer constituent of epoxy and polycarbonate resins used in consumer and healthcare products. Many studies have shown that bisphenol A is a weak estrogen receptor agonist with endocrine disrupting potential in exposed organisms. Presented here are a series of quantitative structure activity relationship models to describe the in vitro hormone activity (estrogen receptor binding, reporter gene induction, and cell proliferation) of bisphenol A and 24 of its analogs. The hormone activity ranged over four orders of magnitude, with bisphenol A displaying intermediate activity. Comparative molecular field analysis, comparative molecular similarity indices, and hologram quantitative structure activity models were generated using SYBYL 6.9. Bisphenols with optimal estrogen activity contained two unencumbered phenolic groups in the para orientation, and multiple alkyl substituents extending from the ring-linking carbon. Bisphenols with methyl group hydrogens replaced by halogens also produced strong estrogenic analogs. These studies suggest that it may be possible to use structure activity models to develop bisphenols that are useful monomers with reduced hormone activity.

IDENTIFICATION OF NUCLEOSIDE AND DNA ADDUCTS FORMED BY [CIS]-2-BUTENE-1,4-DIAL

Michael Byrns¹ and Lisa Peterson^{1,2}

¹*Division of Environmental and Occupational Health,* ²*Cancer Center, University of Minnesota School of Public Health, Minneapolis, MN*

Furan is a toxic and carcinogenic environmental chemical. The underlying mechanism behind furan's carcinogenicity is unknown; it could result from direct DNA alkylation or from non-

genotoxic pathways. Furan is metabolized by microsomes to form [cis]-2-butene-1,4-dial, which is postulated to be the reactive metabolite responsible for furan's biological effects. In order to explore whether DNA alkylation by [cis]-2-butene-1,4-dial could contribute to furan-induced carcinogenesis, [cis]-2-butene-1,4-dial was reacted with each nucleoside. [cis]-2-Butene-1,4-dial reacted with 2'-deoxycytidine (dCyd), 2'-deoxyadenosine (dAdo), and 2'-deoxyguanosine (dGuo), but not thymidine. Our results indicated that [cis]-2-butene-1,4-dial reacted with the exo- and endocyclic nitrogens of dCyd, dAdo, and dGuo to form diastereomeric bicyclic adducts. The initially formed dGuo and dAdo adducts were unstable and rearranged to form secondary products. The secondary dAdo adduct was characterized as the product of dehydration of the initial dAdo adducts, which resulted in the formation of a substituted etheno adduct. The initial dGuo adduct decomposed to form several uncharacterized products, possibly products of polymerization. In order to explore whether these adducts also form in duplex DNA, calf thymus DNA was reacted with [cis]-2-butene-1,4-dial. LC-MS with selected-ion monitoring of DNA hydrolysates indicated the presence of each of the primary adducts in treated, but not untreated, DNA. These results suggest that DNA alkylation by [cis]-2-butene-1,4-dial may contribute to furan-induced carcinogenesis.

GEOGRAPHY SYMPOSIUM

GIS AND THE ENVIRONMENT: CREATING A DEPTH-TO-GROUNDWATER MAP

Rhonda Friberg

Macalester College, St. Paul, MN

Each year, nearly 20 billion gallons of groundwater are extracted from several aquifers lying beneath Ramsey County. The depth of this groundwater—our drinking water—has important consequences for a variety of environmental issues affecting the county. Shallow groundwater levels can be easy entry points for contaminants, and the detection of shallow levels is crucial for building an accurate potential contaminant source inventory. In light of this, the Ramsey Soil and Water Conservation District (SWCD) has been working on a depth-to-groundwater map for all of Ramsey County, using well log data from 1997 to 2003. I will outline the procedure behind the creation of this depth-to-groundwater data layer and the resulting groundwater contour map. I will discuss difficulties encountered during the process of geocoding in GIS software as well as the limitations of the data. Finally, I will present the results and comment on the utility and importance of the depth-to-groundwater project.

THE POLITICAL ECOLOGY OF WATER RESOURCE STRUGGLE IN THE KLAMATH BASIN

Jeff Ramsey

Macalester College, St. Paul, MN

From the beginning of white settlement in the Klamath Basin of southern Oregon and northern California, the most powerful interests have promoted irrigated agriculture above all other water uses. Until the passing of the Endangered Species Act in 1973, there was virtually no recourse for marginalized or downstream groups to oppose the irrigation regime. By this time however, there were already thousands of farmers in the Upper Basin dependent on the water historically granted (but not legally guaranteed) to them by the government. When tribes and environmentalists began demanding more water be set aside for other uses, the government was obligated to concede to their demands without overtaxing the system, resulting in the ceasing of irrigation in 2001. Subsequent appeals to this ruling have left the future use of Klamath water uncertain. This paper examines this conflict through the theoretical framework of political ecology, mapping the political and economic dimensions of human-environmental interaction.

WEAVER DUNES: AN OAK SAVANNA-PRAIRIE ECOTONE

Julia K. Y. Curran, Susy Svatek Ziegler, Doug Prybil

University of Minnesota, Twin Cities, MN

This research examines the history and importance of an oak savanna-prairie ecotone at Weaver Dunes in southeastern Minnesota. Less than 0.02% of pre-European settlement oak savanna remains in the United States today, therefore the research will attempt to reconstruct the landscape evolution of this site thus offering insight into restoration and management possibilities, and to examine current management and restoration goals and methods. Among the questions to be dealt with are: How does this site compare with other remnant oak savannas? How long has oak savanna been present in this location? What is the history of oak intrusion into the prairie? How has fire suppression affected the landscape? What has been the history of this location since European settlement? Methods used to answer these questions include a literature review, tree-ring analysis, and analysis of historical aerial photographs.

SENSITIVITY OF SEDIMENT DELIVERY IN THE UPPER MISSISSIPPI RIVER'S LAKE PEPIN TO HOLOCENE CLIMATE CHANGES

David Kelley

University of St. Thomas, St. Paul, MN

After the last glacial maximum in North America ~18,000 14C years before present (14C yr B.P.), climate zones in the Upper Midwest shifted in

sequence from cold/dry to cool/moist to warm/dry and finally to warm/moist (present climate). Each was characterized by a unique assemblage of precipitation, temperatures, and vegetation. Evidence used to reconstruct the conditions characteristic of each zone come from varved lake sediments, fossil pollen, and remnant shorelines. Here I present independent supporting evidence of a mid-Holocene warm and dry period ~6,600 to 5,400 14C yr B.P. as suggested by its effect on hydrology in the large, complex watersheds serving Lake Pepin, a riverine lake on the Upper Mississippi River. One sub-watershed in south-central Minnesota currently lies along an ecological transition zone with mixed conifer/hardwood forests in the north and a prairie vegetation zone in the south. Sediment transport in this watershed at ~6,000 14C yr B.P. was one-sixth that occurring before or after. The reduction in flow responsible for this decrease is an independent indicator that the climate during the mid-Holocene was warmer and drier than at any time before or after.

GIS AND COMMUNITY DEVELOPMENT

James Hamilton

Macalester College, St. Paul, MN

When planning for the future, community organizations must often look to the past. By examining previous trends in demographics, land use, employment, and housing, communities can better predict and prepare for changes in the future. As a result, many community organizations have begun to use geographic information systems (GIS) to examine the past, take inventory of the present, and plan for future community development. Using the St. Anthony Park Planning District of St. Paul, MN (District 12) as a case study, I will attempt to show how GIS can be effectively used to create long-term community development plans as well as the information and trends community groups consider when planning for the future.

WHERE IS THE AFFORDABLE HOUSING IN ST. PAUL?

Adrienne Hannert

Macalester College, St. Paul, MN

Is housing in St. Paul as affordable as the city claims? How does the city envision the future of its housing and property values? Where are we actually headed? This presentation will show recent GIS work done for the Rondo Community Land Trust on affordable housing in St. Paul. We have analyzed Ramsey County parcel data and 1990 and 2000 Census blockgroup data relating to income and housing value and have compared affordability in the different neighborhoods of St. Paul. We will address future stability, growth and affordability by looking at change between 1990 and 2000 and examining the relationship between housing cost and income.

USING GIS TO DETERMINE TRADE AREAS AND SUITABLE EXPANSION SITES FOR A RETAIL BUSINESS

Sarah Brown and Peter Rieke

University of St. Thomas, St. Paul, MN

Following many years of steady growth, our client, a gift store, is considering expansion to a new location. They currently operate four stores, two of which are highly successful. The client has no systematic data for the demographic profile of their customers. They want such a profile to evaluate a new location, examine their product mix, and decide where to advertise. During a week of normal (non-holiday) business, the client collected address and ZIP code information from customers. Use of this data in GIS allowed construction of a trade area for each store. After trade areas were determined, demographic profiles of each store's customer base were created. The profile of the two successful stores was used as a template for determining the suitability of possible new locations. Using the information and analyses outlined above, several locations were evaluated and the best candidates were recommended to the client

A METHOD OF CONSTRUCTING DEMOGRAPHIC PROFILES FOR FRANCHISES BASED ON THE DEMOGRAPHIC PROFILES OF SUCCESSFUL COMPETITORS

Erik B. Draxten

University of St. Thomas, St. Paul, MN

This study uses GIS to analyze potential locations for a certain franchise of a high-quality fast food restaurant in the Twin Cities metro. Currently, there are two restaurants in the Twin Cities under construction, but the firm plans to open more. No customer data is available from the two existing Twin City franchises, so the demographic profile for a successful franchise is unknown. This particular franchise competes head-to-head with a second franchise. The products, marketing, and overall business plan of the two franchises is almost exactly the same. It is known that three of the competing franchise restaurants have the highest sales of all of those franchises, nationwide. Therefore, this study uses the following procedure. Drive-time polygons are used to estimate the trade area of the three successful competitor locations. These trade-area polygons are then intersected with census block groups. The result is that the demographic profile can be constructed for the three successful competitors. That profile can then be assumed to be the same profile as for the first franchise. Then, the GIS database can be searched for those characteristics. Promising locations included areas with a high population of college-aged people, and with complimentary businesses nearby.

USING GEOGRAPHIC INFORMATION SYSTEMS TO LOCATE SUCCESSFUL FUTURE JIMMY JOHN

Ciao Malta

University of St. Thomas, JRC 432, 2115 Summit Ave, St. Paul, MN

A GIS technique is used to construct demographic profiles of seven successfully-established franchises to better locate more stores. This study uses GIS to analyze successful Jimmy John's sub shop locations and their corresponding demographics within the Twin Cities Metropolitan Area. Jimmy John's is a privately owned Illinois based chain of Gourmet Sandwich shops currently operating seven stores in Minnesota. Specific customer data for these locations is undisclosed, making the demographic profile for a new location unknown. Hence, this study proceeds in the following manner. Computing drive-time polygons identifies trade areas for the seven current locations, which in turn are intersected with U.S. Census Bureau block group demographic data. Once this intersection is performed, the specific demographics of the trade areas are known. Following that, GIS is used to find other locations with similar characteristics. Competing sandwich shops are also mapped. The result is a map of the right demography and areas not saturated with competition, suggesting areas to open successful future Jimmy John's.

THE HOLOCAUST IN LITHUANIA: AN EXAMINATION OF THE HISTORICAL GEOGRAPHY OF JEWISH COMMUNITIES

Amanda Peterson

Gustavus Adolphus College.

Researchers of the Holocaust often encounter toponymical problems related to territorial changes, subsequent orthographical modifications, and simple misinterpretations and errors of the human mind. To clarify and make more accurate the geography of the Holocaust, the United States Holocaust Memorial Museum initiated a research project examining the historical geography of Jewish communities in Lithuania.

A geographical database of the Holocaust in Lithuania was deemed necessary for numerous reasons. Throughout the 20th century, the country has undergone more than ten territorial changes; every border change resulted in toponymical and/or orthographical changes. Also, variations of names and spellings of the same place names in different languages, and even in Lithuanian itself provide reason for a special database. This also would help to clarify between multiple places with identical place names. Additionally, the misinterpretation of the place names due to individual peculiarities of human memory, as well as simple mistakes, largely contributes to inaccurate geographical information for the Holocaust. The database created in the Museum's Registry of the

Holocaust Survivors reflects all "moving" of places between different countries as well as all official and numerous unofficial names of Jewish communities in Lithuania.

Also, we examine various discrepancies between the maps used for researching the historical geography of Lithuania - maps published in the same year but in different countries reveal different boundary lines and numerous orthographic differences. The Lithuania project serves as a pilot project for a much larger goal: the prospective creation of a geographical dictionary of the Holocaust.

SOIL AND WATER CONSERVATION SYMPOSIUM

SOLUTIONS FOR GROWING PROBLEMS:

AGRICULTURE, CONSERVATION AND ENVIRONMENT

Johnson J.

USDA-ARS, North Central Soil Conservation Research Laboratory, Morris, MN

As a global society we are facing many challenges: greenhouse gas emissions, global climate change, limited fossil fuels, declining ecological diversity, food production/distribution and population growth-finite resources. Modern agriculture contributes to both the problems and the solutions. The green revolution resulted in dramatic increases in food production, but has not eliminated world hunger. Greenhouse gases are those that reduce the Earth's ability to loss energy to space. Natural gases that contribute to greenhouse gases include water vapor, carbon dioxide, ozone, methane and nitrous oxide. Burning and plowing of forests, annual tillage release carbon dioxide into the atmosphere, methane from rice paddies and cattle, nitrous oxide from fertilized fields add to the greenhouse gases, but production of biomass and conservation practices that build soil organic matter help to remove greenhouse gases. Research is being conducted to help balance ecological impact and economical needs and goals of agriculture. Organic farming systems, alternative crops, and viable rotation options are receiving increased attention. Research to find the farming systems that maximize carbon storage and minimize the release of nitrous oxide are being established across the US. Biotechnology is being utilized to better understand crop physiology as well as the development of GMO's. Biobased products (biodiesel, ethanol, coproducts, methanol collection) can reduce dependence on petroleum-based products. It is also important to take personal responsibility to solving these global problems. Exercise your power as a consumer and voter. Make a conscious effort to reduce your waste, recycle, and conserve energy and natural resources.

DECOMPOSITION AND COMPOSITION ANALYSIS OF SIBLING *Bt* CORN AND NON *Bt* CORN

Ruther, N, Barbour N, Johnson J

USDA-ARS, North Central Soil Conservation Research Laboratory, Morris, MN

Literature suggested that *Bt* corn has higher lignin concentration compared to its sibling non-*Bt* corn. It was hypothesized that an increase in lignin concentration would result in a decrease in rate *Bt* corn decomposed compared to its non-*Bt* sibling. Reduced decomposition may result in increased residue, which could reduce erosion. However, persistence of *Bt* corn in the soil may also mean an increase in residence time of toxin, increasing potential hazard to non-target organisms and increasing selection potential for toxin-resistant target insects. This study determined the biochemical composition (soluble sugars, starch, hemicellulose, cellulose, lignin, total C and total N) and the rate of decomposition of stover from *Bt* and non-*Bt* corn on stover (2 mm). The ground stover was incubated in a Barnes soil at 25°C and 60% WFPS. Gas chromatograph was used to measure the total respired CO₂ of amended soil periodically over 120 d. A two-component exponential decay model was used to describe the decomposition of the corn residue. The more quickly decomposing material are referred to at the active fraction and the slower component as the passive fraction. The half-life of the active component was 10.6 days for *Bt* corn and 11.4 for the non-*Bt* sibling. The passive component had a half-life of 1066 for *Bt* corn and 1366 for the non-*Bt* corn. Suggesting that the *Bt* corn may decay slightly faster than the non-*Bt* corn. In the field corn stover will also be subjected to predation by macro and meso-fauna, which could alter rate of decomposition.

DECOMPOSING PLANTS—DOES COMPOSITION AND PLANT PART AFFECT DECOMPOSITION RATE?

Nancy W. Barbour and Jane M-F Johnson

USDA-ARS, North Central Soil Conservation Research Laboratory, Morris, MN

Understanding decomposition of plant residue is vital to understanding C and N cycling, both in terms of plant nutrient needs and global change. Roots typically constitute less than half the total plant biomass but literature suggests they contribute 1.4 to 1.8 times as much C to the soil as above ground plant biomass. This study addresses the related issues of plant composition, residue decomposition, and C and N cycling. The first objective was to compare the biochemical composition of roots, both among species and with leaves and stems. The second objective was to evaluate the decomposition rates of roots, leaves and stems among species and relate those rates to biochemical composition and to C and N mineralization rates. Plant materials from C3 and C4 species were collected at physiological maturity.

Structural and nonstructural components from roots, stems and leaves were measured. Decomposition of plant material in soil was monitored as evolved CO₂ at 25°C and 60% water-filled pore space. Chemical composition and decomposition varied among species and plant organs.

CORN STOVER AS A BIOFUEL

Johnson J, Reicosky D, Sharratt S, Lindstrom M, Voorhees W

USDA-ARS, North Central Soil Conservation Research Laboratory, Morris, MN

Corn stover is one of several feedstocks being considered as a biofuel. Although corn stalks currently are not harvested routinely, the huge amount of biomass produced annually makes corn a potential commercial biofuel. Removal of crop residue from the field needs to balance against preventing soil erosion, maintaining soil organic matter levels, and preserving or enhancing productivity. After corn stover is fermented to produce ethanol, the remaining residue is about 70% lignin. Lignin decomposes slowly, which can help stabilize soil structure. One use of fermentation by-product would be as a soil amendment, thereby minimizing some of the negative impacts of stover removal on soil structure. Laboratory studies show that by-product of stover fermentation increased microbial biomass and soluble C by 20% compared to soil with out amendment. In the severely eroded soil, humic acid concentration ($r^2=0.84$, $p<0.0001$) and aggregate stability ($r^2=0.35$, $p<0.001$) increased linearly with increased fermentation by-product concentration. Thus, laboratory results suggest that this fermentation by-product has potential as a soil amendment. Returning by-product to the field may slow the loss of soil organic matter caused by removing corn stover. Careful management of stover removal (avoiding eroded or erosion prone areas) and selective placement of the by-product could contribute to a sustainable use of corn stover for ethanol production.

ANNUAL MEDICS (*MEDICAGO* SPP.) CAN HELP DEVELOP SUSTAINABLE

AGRICULTURE IN THE UPPER MIDWEST.

A. A. Jaradat, J. Johnson, S. Van Kempen, and N. Barbour.

USDA-ARS, North Central Soil Conservation Research Laboratory, Morris, MN

Recent interest in sustainable cropping systems has renewed interest in legumes as forage, cover, N-fixing, weed smothering, living mulch crops, and to reduce soil erosion. Annual medics, *Medicago* spp. closely related to perennial alfalfa, grow rapidly, produce large amounts of biomass with many pods, supply nitrogen through nitrogen fixing bacteria, are adapted to a wide range of soil types, and have hard seeds that remain viable in the soil. Medics do have

potential uses in sustainable agriculture systems, however, additional research is needed to clearly define their niche, especially in the upper Midwest. A large (>500 accessions) germplasm collection was assembled from international sources and is being screened, characterized and evaluated for adaptation, growth rate, biomass production and carbon sequestration capability under the short-growing season of the upper Midwest. The objectives of this study are to identify adapted accessions with the maximum combination of: 1) rapid growth rate, high nitrogen fixation rate in symbiosis with the soil bacterium *Sinorhizobium*, and large biomass production, 2) adequate levels of *Phytophthora* root rot resistance required under cool, wet soils, 3) dual utilization as forage or hay, 4) shade tolerance as companion crops, and 5) high below ground carbon storage capacity.

DEVELOPMENT OF *CUPHEA* AS A UNIQUE OILSEED CROP FOR THE U.S.

Russ Gesch, Frank Forcella, Brenton Sharratt, Alan Olness, and David Archer

USDA-ARS, North Central Soil Conservation Research Laboratory, Morris, MN

Saturated plant oils composed of small and medium-chain triglycerides (i.e., C8:0 to C14:0) are extensively used in the chemical manufacturing industry. Yet, in the U.S. there currently are no crops grown to meet industrial demands. Several species from the genus *Cuphea* produce large quantities of such oils and some have potential for agronomic domestication. Recently, semi-domesticated lines developed from an interspecific cross between *C. viscosissima* and *C. lanceolata* have been shown to be successfully grown in west central Minnesota. *Cuphea* offers to be a true alternative crop that could be used in rotations that are already lacking in diversity. Our research with semi-domesticated *cuphea* has focused on developing agricultural management practices for its production and identifying potential environmental and agronomic limitations. Utilizing row-cropping equipment common to Midwest farmers, we have been relatively successful in establishing *cuphea*, and producing seed yields as high as 1.0 Mg ha⁻¹. We have found that *cuphea* may be susceptible to drought, and heat-stress when incurred at reproductive phase. Difficulties associated with weed control, seed harvesting and processing still exist. Although some obstacles still remain, results appear favorable for agronomic production of *cuphea* in the near future.

SIMULATION MODELING TO PREDICT THE ADOPTION AND ECONOMIC

VALUE OF A CROP TECHNOLOGY INNOVATION

David Archer

USDA-ARS, North Central Soil Conservation Research Laboratory, Morris, MN

Simulation modeling is a useful tool for identifying the potential impacts of technology innovations. The use of simulation modeling in this capacity is illustrated for the case of a temperature-sensitive polymer seed coating that has recently been introduced. This information is important both to a company who is trying to market the new technology and to the potential users of the technology. For this analysis, we take the perspective of a typical farmer as a potential user of the technology. Simulation modeling is used in three ways in the analysis. The effect of random weather events and cropping system are used in the EPIC simulation model to: 1.) identify field conditions that determine *when* the technology can be used and 2.) identify crop yields and production costs that quantify *what* happens when the technology is used. Finally, an economic model is constructed using a decision-tree approach to 3.) incorporate the *when* and *what* into the user's management plan to see *how* the technology will be used. Integrating these three components provides a framework for predicting the extent to which this new technology will be used, the effect of the technology on cropping practices, and the economic value of the technology to crop producers.

SALT AFFECTED SOILS IN SOUTH DAKOTA

C. Gregg Carlson

Plant Science Department, South Dakota State University, Brookings, SD

Throughout much of the central Corn Belt, soil salinity problems seldom are a significant impairment to the production of agronomic commodities. However, as we look to the western edge of the Corn Belt, the area where evapotranspiration exceeds precipitation, we find that because drainage is less developed, salts are less apt to be carried out of a watershed, and soil salinity problems can and do occur more frequently. Naturally high levels of soil salinity are often found, farming tillage practice induced soil salinity has been documented, and irrigation induced salinity has been responsible for causing cropping system failures. An overview of how salinity can naturally cause problems and how man has contributed to Salinization problems will be discussed. A discussion of how management can be used to minimize salt problems concludes the discussion.

FOUR NORTHERN GREAT PLAINS SOILS: THEIR UNIQUE CHEMICAL SIGNATURES

Alan Olness(1), M. Lieser(2), H. Weiser(3), B. Kunze(4) and J. L. Rinke(1)

(1) *USDA-ARS North Central Soil Conservation Research Lab. 803 Iowa Avenue, Morris, MN 56267 and USDA-NRCS in Minnesota (2), N. Dakota (3) and S. Dakota (4).*

Most soils in the Northern Great Plains are managed as if little variation occurred within the landscape. The current study was undertaken to determine the chemical nature of four soils in Western Minnesota, Eastern South Dakota, and Central and Eastern North Dakota. A Resin extraction technique was applied to samples of four adjacent soils (Barnes, Buse, Langhei, and Svea) collected on 23 sites. Extracts were analyzed for 20 elements by inductively coupled plasma. Samples were also subjected to conventional analyses for available P, K, total and inorganic C, total N and pH. Conventional soil analyses showed little differences between soils; they were generally rich in available P, and K. The Barnes, Buse and Svea soils were relatively rich in organic C and N. The pH values followed the order Svea = Barnes < Buse < Langhei. Resin extractions provided some unexpected results. As a consequence of complexes with exceptionally large amounts of Ca and Mg in the Langhei soil, more than 90 % of the resin extractable anions such as S and B were extracted with cationic resins. Bicarbonate extractable P was often correlated with resin extractable P with the exception of the Langhei soil for which no relationship was observed. The characteristics of these soils that were revealed by resin extraction point to management options for each soil such as fertilizer placement and composition.

LEACHING LOSSE OF NITROGEN FROM STOCKPILED MANURE IN SEASONAL GRAZING DAIRY SYSTEMS

Frantisek Majs, Dr. Neil C. Hansen, Dr. Michael P. Russelle

University of Minnesota, Twin Cities, MN

Winter-feeding is a challenge for grazing based livestock systems. Low input dairy system may use outdoor winter-feeding in lots that provide protection from weather and a straw bedded pack is used to keep cows dry. The water quality risk associated with outdoor winter-feeding of dairy cows is not well known. The objective of this paper is to evaluate potential risks of leaching of nitrogen from stockpiled manure obtained during outdoor wintering of dairy cows. Soil nitrate and ammonium concentration in the wintering lot was determined with grid soil core sampling and used as an evidence of leaching from the manure. Manure from the straw bedded pack was stockpiled in the spring in lot and left

to compost. Leachate from the piled manure was sampled weekly using passive samplers at the soil surface and analyzed for nitrate and ammonium concentration. The data were extrapolated to determine potential for nitrogen discharge to the local watershed.

RIBOGRO ENHANCES ROOTING DEVELOPMENT

Fernholz KM, Seifert JG, Shecterle LM, St.Cyr JA
Fernholz Farms

A strong root system is vital to plant health and growth. The purpose of this experiment was to determine the effects of RiboGro (RG) on root development and appearance. Three treatments were tested: water (W), low concentration RG (L) (1 tsp/16 ozs), and high concentration (H) (1 tsp/4 ozs). Each treatment group had $n = 6$. The seeds were planted on day 0 and equally watered at regular intervals. The seedlings were uprooted, weighed, and the tap roots were measured for length at days 5 and 10, and the average change is reflected below: Treatments Measured weight (gm) Tap Root Length (cm) W -0.27 4.1 RG-L 1.76 22.98 RG-H -0.29 4.1 There were significant differences between L and H and L and W for both weight (L vs. H, $p = 0.02$; L vs. W, $p = 0.04$); and tap root length (L vs. H, $p = 0.01$; L vs. W, $p = 0.02$). There were no significant differences between H and W for either weight or tap root length. Many of the seeds uprooted on day 10 showed signs of rotting or splitting (W=4/6, L=1/6, H=4/6), probably due to excessive moisture. These results imply that a low concentration of RiboGro may be beneficial to developing roots in less than ideal conditions.

USING GIS TO EVALUATE NITRATE LEACHING AND WELLHEAD PROTECTION IN THE VERDI WELLFIELD, LINCOLN COUNTY, MN

Kyle J. Symoniak

University of St. Thomas, St. Paul, MN

Excessive fertilization of agricultural lands can lead to health risks if this nitrate-rich runoff enters a drinking water aquifer. Officials testing soils and wells in the Verdi Wellhead Protection Area have found nitrate levels dangerously close to the 10ppm USEPA drinking water safety standard. Using a GIS, it is possible to locate farmed fields with high soil permeability and revise the Best Management Practices (BMPs) in place in these areas. Areas of high soil permeability were determined in the following way: A soils layer was extracted from a 1970 Lincoln County soil survey by tracing the original paper survey onto Mylar sheets, scanning those sheets, and heads-up digitizing the soil boundaries. Air photos were then used to identify County Land Units that are currently being farmed, producing a layer of farmed areas in the Wellfield. The farmed areas were then overlaid onto the soils layer, producing a farmed areas layer that includes the soil horizons. GLEAMS (Groundwater

Loading Effects from Agricultural Management Systems) models were applied to determine which areas are highly susceptible to nitrate leaching. To prevent further nitrate contamination to the sensitive aquifers, BMPs in these highly susceptible areas will need to be altered. Examples of changes can include: applying for subsidies under the Conservation Reserve Program to leave the land unfarmed, reduce the amount of fertilizer used, or switching to perennial crops such as alfalfa, which require much less fertilizer than the annuals currently present on most of the areas in the Wellfield Protection Area.

WINCHELL UNDERGRADUATE RESEARCH SYMPOSIUM

INFRARED (THz) SPECTROSCOPY WITH FEMTOSECOND TIME RESOLUTION

Evan Acharya

Macalester College, St. Paul, MN

An optical pulse hitting a semiconductor surface produces a picosecond electromagnetic pulse whose electric field can be measured as a function of time. Fourier transformation of this yields a spectrum which probes interesting properties of the semiconductor. We built a system to perform infrared (THz) spectroscopy with femtosecond time resolution. We produced the THz electromagnetic pulse by shining (reflecting or transmitting) an excitation optical pulse of wavelength 400 nm or 800 nm from a femtosecond laser onto a semiconductor surface. We then measured the electric field using electro-optic sampling.

DEVELOPMENT OF A DNA-BASED TAXONOMIC KEY FOR FRESHWATER MUSSELS OF THE ST. CROIX RIVER: EXAMINATION OF VARIABILITY WITHIN THE ITS-1 TARGET SEQUENCE

Erica F. Andersen

Macalester College, St. Paul, MN

The St. Croix watershed contains 40 freshwater mussel species; 14 are regionally threatened, two are federally endangered. Larval forms of mussels (glochidia) are obligate parasites of fish hosts. The specificity of this relationship yields one method for their conservation. The ITS-1 (internally transcribed spacer) region lies between the 18S and 5.8S coding regions for rRNA. We are constructing a DNA-based taxonomic key, using this region, for identification of mussel species in glochidial or microscopic juvenile stages. One measure of the reliability of the key is the lack of ambiguity at the species level. While interspecific variation of the ITS-1 region has been observed, little is known about the region's conservation within a single species. Since large populations tend to exhibit more variation,

abundant species pose as good models for ITS-1 evaluation. Mussel tissue was collected from two such species, (*A. plicata*) and (*F. flava*), at two river sites ~40 km apart. DNA was extracted and the ITS-1 region was amplified by PCR, followed by restriction endonuclease (RE) digestion. Four REs displaying unique banding patterns for each species were used. PCR and RE products were compared among individuals using agarose gel electrophoresis to examine whether variation in this region exists.

SMALL MAMMAL TRAPPING SUCCESS IN NATIVE VS. NON-NATIVE PRAIRIE GRASSLANDS

Rob Anderson

Bethel College, St. Paul, MN

The purpose of this study was to determine if small mammals have a habitat preference towards native or non-native grasslands. Two locations along the St. Croix River Valley, one in Minnesota and one in Wisconsin, were chosen as field sites because both had adjacent plots containing either native C4 warm season grasses with a diversity of forbs or mostly non-native C3 cool season grasses such as quack, brome and bluegrass. Sherman traps were placed and bated along transects in each field. Captured mammals were tagged, weighed, sexed, their capture location recorded and then released. The trapping success in the fields containing native plantings was at least twice as great as that in the fields containing non-native grasses. Animals trapped included meadow jumping mouse (*Zapus hudsonius*), white-footed mouse (*Peromyscus leucopus*), meadow vole (*Microtus pennsylvanicus*), northern short-tailed shrew (*Blarina brevicauda*), and pygmy shrew (*Sorex hoyi*). The frequency and distribution of these animals was unique in each field type. It can be speculated that small mammals may have a preference towards grasslands with native plantings due to greater plant diversity and greater plant structural diversity than grasslands containing non-native plantings.

A PROTEOMIC ANALYSIS OF THE BLOOD-BRAIN BARRIER

Nabamita Basak

University of Minnesota, Duluth, MN

The blood-brain barrier (BBB) of mammalian systems is an important cellular system of selective permeability. It permits the entry of a selected set of nutrients and chemicals, yet remains impermeable to a myriad of others. The BBB is composed of single layered capillary endothelial cells connected by tight junctions. It is widely believed that the structure and composition of the luminal and abluminal sides of the endothelial cell are the primary determinants of the

discriminating properties of the BBB. In this contribution, proteins of the luminal and abluminal sides of bovine brain endothelial cells were subjected to proteomic analysis and comparison. Bovine brain microvessels were isolated from cerebral cortex grey matter, extensively homogenized, and fractions containing luminal and abluminal membranes were separated via centrifugation on a discontinuous Ficoll gradient (provided by Dr. D. Peterson, Chicago Med). The protein makeup of each fraction was analyzed via two-dimensional polyacrylamide gel electrophoresis (2-D PAGE) and sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE). Proteins were visualized with SYPRO Ruby protein gel stain, excised from the gels, and subjected to trypsinization prior to characterization by MALDI-TOF MS analysis. Preliminary results clearly demonstrate that there exists differential expression of certain proteins between the luminal and abluminal membranes of brain endothelial cells. This asymmetric distribution is corroborated by Annexin I that was found to be more prevalent in the luminal side, and Annexin II that appeared more abundant in the abluminal side. The quantitative difference in the localization and expression of many proteins indicates that the luminal and abluminal sides have distinct molecular environments, which may lead to different modulatory effects of the two plasma membrane domains in BBB functionality.

CHARACTERIZATION OF THE *Arabidopsis* SEEDLING PLASTID MUTANT SPD2

Victoria Bedell

Bethel College, St. Paul, MN

The aim of this study was to characterize the "spd2" *Arabidopsis* mutant and compare it to "spd1" and wild type. It was found that the mature "spd2" plant produced less chlorophyll than both wild type and "spd1". The few cells in the cotyledons that have chloroplasts are mostly found around the vascular tissue or are placed sporadically around the cotyledon. However, the "spd2" seedling produced more anthocyanins than "spd1" and wild type. Both "spd1" and "spd2" are agravitropic when compared to wild type. Polymerase Chain Reaction was used to map the SPD2 gene, which is located near the classical map position 85 cM chromosome one.

THE EFFECTS OF CO₂, N, AND SPECIES DIVERSITY ON SEED PRODUCTION IN PRAIRIE PLANTS

Louise Bier

The effects of changing levels of CO₂, N, and species diversity on plant communities will depend on the life histories of the plants. Increasing resource availability may increase photosynthetic and growth rates, increase survival probability, and increase

fecundity and seed production. This study examined the effects of CO₂, N and species diversity levels on seed production of tallgrass prairie plant communities. Plant species were chosen from all four functional groups (C3, C4, N-fixers and forbs) and treated with elevated or ambient CO₂, elevated or ambient N, and one of four levels of species diversity (1, 4, 9 or 16 species). The results showed no clear trends in responses of any functional group, suggesting that such groupings are not useful for predicting levels of seed production in response to CO₂, N and diversity. Few plants overall showed an increase in seed production in response to increased resources. This finding could be due to a trade-off between competition and colonization with most plants using increased resources for growth and survival rather than reproduction.

CASE STUDIES OF RECENT OROGRAPHIC FLASH FLOODS

Brian Billings

St. Cloud State University, St. Cloud, MN

Flash floods are the leading cause of severe weather related deaths in the United States. A large number of these floods are created due to forcing by local topography. Lin et al. (2001) identifies four of the common ingredients in orographic flash floods based on eleven case studies. This small sample size makes drawing broad generalizations difficult. Therefore, the purpose of this research was to perform additional case studies to either extend the basis of Lin's ingredients or to determine that some of them are unnecessary. Case studies were performed for three cases of orographically induced flash floods: the Las Vegas, NV flood of July 8, 1999; the Oroville, WA flood of July 12, 2001; and the El Paso, TX flood of August 2, 2002. For each case, surface and upper-air maps were plotted from raw observational data and subjectively analyzed. Atmospheric soundings were plotted from raw data, while station time-series were computer-generated. Radar and satellite imagery were also obtained from historical archives. Preliminary results showed that three of Lin's ingredients clearly appear in each case: (1) a steep mountain, (2) an unstable airmass, and (3) a quasi-stationary, large-scale system that slows the storm over the threat area. The fourth ingredient, a very moist, low-level jet, was difficult to identify in two of the three cases. Further investigation, along with better observations, could determine how important this feature is to the formation of orographic flash floods.

FINAL JUSTICE: A COMPARATIVE SURVEY OF INTERNATIONAL CRIMINAL TRIBUNALS IN YUGOSLAVIA, RWANDA, AND TOKYO (1993-2000)

Ryan Black

University of Minnesota, Minneapolis, MN

In recent years international war criminal tribunals concerning the issue of women's human rights have proliferated across the landscape of civil society. Following the international war crime tribunals for the former Yugoslavia (1993) and Rwanda (1994), in December 2000, a tribunal was convened in Tokyo to address the sexual slavery perpetrated by the Japanese military during World War II. I believe the international tribunal is a new and promising venue to achieve human rights. Our project is to research the comparative histories of these three tribunals and their contributions to the international community. Specifically, I will address the following questions: 1. How successful have the Tokyo, Rwandan, and Yugoslavia tribunals been at creating a political culture that can go beyond localized nationalist politics? 2. How has each case developed the language and usage of "human rights" for women's rights? 3. To what extent have international criminal tribunals (ICT) enhanced the legitimacy of international law as a force in international relations? 4. The 20th century and the 21st have experienced a groundswell in violent conflict, especially towards women. What role, if any, should we expect/desire ICT to play in adjudicating such conflict and providing justice to the victims?

UROKINASE-TYPE PLASMINOGEN ACTIVATOR SIGNALLING IN HUMAN BREAST CELLS.

Heidi Boyum, Michelle Hagen, Hillary Thronson, Joseph Provost and Mark Wallert

Minnesota State University, Moorhead, MN

The sodium-hydrogen exchanger (NHE1) is a mechanism responsible for intracellular pH (pHi) regulation. NHE1 exchanges intracellular H⁺ for extracellular Na⁺ in a 1:1 ratio. This activity results in an extracellular acidification that facilitates cellular motility in both normal and tumorigenic cells. In addition, NHE1 activity is linked to the formation of stress fibers. These structures may or may not play a role in cell migration and invasion. The epidermal growth factor pathway involving extracellular signal-regulated kinase (ERK) is one way that regulates NHE1 activity. The ERK pathway has been directly linked to some forms of breast cancer. Approximately one-half of all breast tumors express more activated ERK as compared with surrounding benign tissue. NHE1 can also be activated by a pathway that is independent of ERK, which relies on a protein known as Rho-associated kinase (ROCK). Once ROCK activity has been initiated, it can then either directly activate NHE1 or indirectly activate the exchanger via RhoA. NHE1 activation leads to stress fiber formation,

which may induce tumor cell migration. Urokinase-type plasminogen activator (uPA) binds to the uPA receptor (uPAR) and facilitates a proteolytic cascade. uPAR is a multifunctional protein that initiates signaling events that affect cell adhesion, migration and proliferation. The pathway by which uPA acts is still unknown, however, a striking feature of malignant solid tumors is the over-expression of uPA. Present data shows that uPA activates ERK in various breast cell lines. The pathway by which uPA acts has been analyzed using the ERK inhibitor PD98059 as well as the ROCK inhibitor Y27632. Further analysis of the RhoA pathway was conducted by stably transfecting breast cells with fluorescently labelled RhoA. Finally, wound assays were conducted to explore cell migration in response to uPA stimulation.

DATA EXPLORATION TOOLS FOR THE GENE ONTOLOGY (GO) DATABASE

Paulo Casaes, Edward Donkor, Lisa Lesnett, Getiria Onsongo, Erla Osk Petursdottir, Dennis Tkach, Elizabeth Shoop

Macalester College, St. Paul, MN

The GO Consortium is an effort to standardize nomenclature for genes and categorize gene products. This consortium has built a database containing genes and has placed them in three different categorization schemes, called ontologies. These ontologies are very large directed graphs. The amount of information in this database is huge, and current tools are unable to clearly display it. Additionally, existing tools do not enable users to perform particularly complex searches. In an effort to improve this situation, we built a 3-tier software system to clearly and interactively display the GO data and to perform complex queries against the database. Our system features reusable software components that can accommodate various future additions.

INTENTIONAL FORGETTING OF VISUALLY PRESENTED STIMULI

Amos B. Cass

Minnesota State University, Mankato, MN

The ability of individuals to intentionally forget items was assessed. The participants viewed 40 slides of common images, a random half of which were followed by a "remember" instruction and the remaining by a "forget" instruction. Individuals were instructed beforehand to commit to memory only the pictures followed by a "remember" instruction for later assessment. After all the slides were presented, individuals were instructed to free recall over three assessment sheets both the "remember" and "forget" images. Free recall of all images increased over the subsequent tests. Images followed by a "remember" instruction were always recalled at a higher rate than

images followed by a "forget" instruction, but overall recall was not inhibited by intentional forgetting instructions. These results indicate that although participant's performance increased, intentionally forgotten images entry into memory was apparent, but not overwhelming.

THE STRUCTURE AND SOLID-STATE PHASE TRANSITION BEHAVIOR OF 3,4-BIS(4-CHLOROPHENYL)FUROXAN

Brooke M. Christensen and William H. Ojala
University of St. Thomas, St. Paul, MN

Polymorphism, the occurrence of a solid compound in more than one crystal structure, is of interest in materials science, in which the useful physical or chemical properties of a material may depend on the packing arrangement of its molecules, and also in biomedical science, in which the solubility and bioavailability of a drug may depend on its particular crystal structure. We have been studying the polymorphism shown by 3,4-bis(4-chlorophenyl) furoxan, which occurs in two crystalline forms. A low-temperature form of this compound is stable indefinitely at room temperature, but it is converted by heating in the solid state to a high-temperature form, which is also apparently stable indefinitely at room temperature. The low-temperature form can be obtained by crystallization of the solid from ethanol; the high-temperature form can be obtained independently of heating by crystallization from carbon tetrachloride. The crystal structure of the low-temperature form has been published by previous workers, but that structure was not refined to a very great extent. We have re-determined the crystal structure of the low-temperature form at 173K and have also determined the crystal structure of the high-temperature form at 173K. The low-temperature form is orthorhombic, with space-group symmetry Pbcn. The high-temperature form is monoclinic, with space-group symmetry C2/c. Both forms show evidence of crystallographic disorder. In the interest of "crystal engineering," we are currently evaluating the similarly substituted oxadiazolone, a molecule closely similar in size and shape, for potential incorporation into the crystalline furoxan as a means of influencing the phase transition.

THE EXPRESSION OF MAIZE CHROMOSOMES INVOLVED IN C4 PHOTOSYNTHESIS IN OAT-MAIZE ADDITION LINES

Kim Clifton

St. Mary's University of Minnesota, Winona, MN

Oat carries out C3 photosynthesis and maize carries out C4 photosynthesis. C4 photosynthesis is deemed to be the more efficient process. Oat-maize addition lines were compared to normal oat plants for

structural differences of leaf anatomy and chloroplast production. Oat-maize addition lines are oat plants that include one or more maize chromosomes within the oat genome. PCR was used to verify the presence of maize DNA in the oat-maize addition lines. Cryostat microtoming was used to obtain cross-sections of leaf tissue which were then microscopically examined for C4 characteristics. The presence of bundle sheath cells and/or the increase of chloroplasts would be an initial indication of an expression of the maize DNA in these lines. Two addition lines showed an increase production of chlorophyll compared to normal oats. However, none of the addition lines showed bundle sheath cells. The enzyme phosphoenolpyruvate carboxylase, critical for C4 photosynthesis, could still be present in some of these plants. The expression of C4 characteristics in the oat-maize addition lines could possibly lead to more efficient oat plants.

SYNTHESIS OF 3,4-DIMETHYLPHTHALIC ANHYDRIDE

Christopher Clark and Wayland E. Noland

University of Minnesota, Twin Cities, Minneapolis, MN

For the purpose of crystallographic studies, and due to its isosteric resemblance to other molecules, a synthesis of 4,5-dimethylphthalic anhydride was undertaken. Several isosteric compounds similar to the anhydride have been prepared previously, including 4,5-dichlorophthalic anhydride and 5,6-dichlorobenzofurazan 1-oxide. Many reaction pathways were reviewed; the path chosen was short, involving three steps with cheap reagents. *o*-Xylene was chloromethylated (twice) using a solution of paraformaldehyde in aqueous hydrochloric acid. The product, 1,2-bis (chloromethyl)-4,5-dimethylbenzene, was oxidized under phase-transfer catalysis, using tetraethylammonium bromide with potassium permanganate, in a binary system of water and dichloromethane. The oxidation product, 4,5-dimethylphthalic acid, will then be thermally dehydrated to the anhydride, which will then be purified and analyzed by NMR, IR, and MS spectroscopy.

THE STRUCTURE OF "ITCA", A METABOLITE OF CYANIDE

S. E. Cummings^{1,2}, S. I. Baskin³ and H. T. Nagasawa^{1,2}

¹VA Medical Center, ²University of Minnesota and ³USAMRICD

L-2-Iminothiazolidine-4-carboxylic acid (ITCA), a urinary metabolite of cyanide (a military/civilian threat agent), is produced in vivo by reaction of cyanide with the endogenous amino acid, L-cystine. A number of synthetic methods for ITCA are available; however, many of these give racemic ITCA, which is not useful for biological studies. We have

developed a simple, one-step/one-pot synthesis for L-ITCA by condensation of L-cysteine with cyanamide. The course of the reaction can be followed readily by monitoring the NH₃ liberated, as well as by tlc. By this means, chiral L-ITCA {[α]_D23 -93.1° (c 1.13, H₂O)}, Anal. (C₄H₆N₂O₂S) C, H, N, was prepared in recrystallized yields of 45%-50%. By using D-cysteine, D-ITCA {[α]_D23 +93.0° (c 1.02, H₂O)} was obtained. Because the literature is ambiguous about the structure of "ITCA", the L-ITCA prepared above was submitted for x-ray crystallographic analysis. We report that the x-ray data conclusively demonstrate that the ring structure of "ITCA" is not a thiazolidine, but a thiazoline, i.e., the structure of L-"ITCA" is, in fact, 2-amino-2-thiazoline-4(R)-carboxylic acid, and the compound exists as a zwitterion even in crystalline state. Henceforth, this compound should be referred to by its proper acronym, L-ATCA. (Supported by the Department of Veterans Affairs and USAMRICD. We thank Dr. Victor Young of the University of Minnesota for the x-ray crystallography.

WEAVER DUNES: AN OAK SAVANNA-PRAIRIE ECOTONE

Julia K. Y. Curran, Susy Svatek Ziegler, Doug Prybil
University of Minnesota, Minneapolis, MN

This research examines the history and importance of an oak savanna-prairie ecotone at Weaver Dunes in southeastern Minnesota. Less than 0.02% of pre-European settlement oak savanna remains in the United States today, therefore the research will attempt to reconstruct the landscape evolution of this site thus offering insight into restoration and management possibilities, and to examine current management and restoration goals and methods. Among the questions to be dealt with are: How does this site compare with other remnant oak savannas? How long has oak savanna been present in this location? What is the history of oak intrusion into the prairie? How has fire suppression affected the landscape? What has been the history of this location since European settlement? Methods used to answer these questions include a literature review, tree-ring analysis, and analysis of historical aerial photographs.

THE ACTIVITY AND REGULATORY PROCESSES OF THE FOXO3A TRANSCRIPTION FACTOR IN RELATION TO OXIDATIVE STRESS.

Jennifer Dale, Kimberly Mulder, Jessica Heck, Diane Nelson and Michelle Malott
Minnesota State University, Moorhead, MN

The FOXO family of proteins has been recognized as critical to cellular processes such as development, cell division and apoptosis. As a result, these proteins play a pivotal role in the regulation of cellular differentiation and cell proliferation, both

during development and in adult. FOXO3a is thought to regulate expression of genes involved in both the cell cycle and apoptosis as this protein is part of the phosphoinositide-3-kinase (PI3-K) signal transduction pathway and is also thought to induce a program of gene expression that allows for the repair of DNA damage caused by ROS. Interestingly, the capacity cells have to repair DNA damaged by oxidative stress from reactive oxygen species (ROS) correlates to increased longevity. This apparent opposing action of FOXO3a in signal transduction pathways involved in cellular proliferation and in pathways that provide protection against ROS-induced damage may outline a system that provides checks and balances for coupling cell-cycle regulation and apoptosis. Our research aims to examine the molecular link between FOXO3a phosphorylation in response to ultra-violet (UV) radiation, a form of oxidative stress, and apoptosis in Chinese hamster lung fibroblasts (CCL39). Our data indicate that FOXO3a is phosphorylated on Thr32 in response to UV and we hypothesize that this phosphorylation may in part, be due to the activation of the p38MAPK pathway. Since FOXO3a phosphorylation is known to be part of an anti-apoptotic PI3-K pathway we are interested in understanding the relationship between the observed FOXO3a phosphorylation and cell survival.

A NEW MEMBER OF THE RIM101 PATHWAY LINKS PH SENSING TO ENDOCYTOSIS/VACUOLAR FUNCTIONS

Dana Davis

University of Minnesota, Minneapolis, MN

Candida albicans is the most common pathogenic fungus in humans. It has the unique ability to infect a wide range of tissues, thus it must respond to diverse environments. One important environmental condition that affects *C. albicans* physiology is extracellular pH. The most striking effect being on its morphology. In acidic environments, *C. albicans* grows in the yeast form and in alkaline environments, it grows in the filamentous form. [RIM101] encodes a transcription factor that regulates pH responses and its activity depends on upstream members of the [RIM101] pathway. A genomic two-hybrid screen in *S. cerevisiae* identified Snf7 protein as a potential member of the [RIM101] pathway. Thus, we hypothesized that [SNF7] encodes a member of the [RIM101] pathway. To test this hypothesis, we created a [snf7] deletion mutant in *C. albicans*. The [snf7] mutant had phenotypes which include a filamentation defect in alkaline environments and growth defects on LiCl and alkaline media, similar to the [rim101] mutant. From the two-hybrid analysis, we predicted that [SNF7] encodes an upstream member of the [RIM101] pathway. To test this hypothesis, we integrated the constitutively active [RIM101-405]

allele, which bypasses the requirement of the upstream [RIM101] pathway members, into the [snf7??] mutant. [RIM101-405] rescued growth and filamentation defects of the [snf7??] mutant. Thus, we conclude that [SNF7] encodes an upstream member of the [RIM101] pathway. Snf7 protein is required to fuse the endocytic vesicles to the vacuole. This suggests a possible link between endocytosis and the [RIM101] pathway.

EVIDENCE FOR AN ENZYME THAT REGULATES THE C4 PHOTOSYNTHETIC PATHWAY IN CHLOROPLASTS OF C3 PLANTS

James E. Denker and Chris Chastain
Minnesota State University, Moorhead, MN

In C4 plants, PPDK has the well-known role of regenerating the primary CO₂ receptor, PEP, in mesophyll chloroplasts. It is regulated by light/dark induced reversible phosphorylation of an active-site threonine. PPDK Regulatory Protein (RP), a unique bifunctional protein kinase/phosphatase, mediates this reversible phosphorylation. Recently, we demonstrated that PPDK in chloroplasts of C3 plants, although of nonphotosynthetic function, undergoes the same light/dark induced reversible phosphorylation as does C4 PPDK. In this poster, we now provide further evidence that this reversible phosphorylation is most likely due to a C3 RP isoform by demonstrating Pi-dependent/PPDK-dephosphorylating activities in spinach (C3) chloroplast lysate. Additionally, we present evidence that RP is exclusively localized in chloroplasts. The importance attached to the latter is that regulation of C3 PPDK by RP does not extend to the cytoplasmic localized isoform, which is thus presumed to be constitutively active.

DEHYDROGENASE ISOLATED FROM *Citrullus vulgaris*

James Denker, David Ronderos and Joseph Provost
Minnesota State University, Moorhead, MN

Glyoxysomal malate dehydrogenase (MDH), an enzyme that is responsible for the reaction converting malate to oxaloacetate, is a dimeric protein that is found in the mitochondria and cytosol of eukaryotic cells. To better understand the mechanism whereby MDH binds malate in *Citrullus vulgaris*, watermelon, the identity of a key amino acid residue, believed to be important in stabilization of the substrate-enzyme complex, will be altered. Residue 86, a valine, will be modified to lysine via point mutation. Through polymerase chain reaction amplification techniques, we will proliferate our mutant for use in analytical assays measuring the kinetic consequences of the aforementioned reaction and hope to gain insight into the stability of the enzyme-substrate complex as it relates to the steric interaction by this specifically manipulated amino acid residue.

A STUDY IN NETROPSIN BINDING TO AMINOPURINE SEQUENCES OF DNA

Christina L. Diller, Sri Sai Sowmya Gandham, Kirsten C.S. Hall

Gustavus Adolphus College, St. Peter, MN

Netropsin is a naturally occurring antibiotic that obtains pharmacological activity from its ability to bind DNA. As a result of this DNA-binding capability, there has been great interest in netropsin and several of its analogs for use in treatment of a variety of diseases, including several forms of cancer. The ability of netropsin to bind to and quench fluorescence of 2-aminopurine was studied. Fluorescence spectroscopy was used to experimentally measure the fluorescent emission of 4.8 μ M 2-aminopurine in solutions containing 0 μ M, 5.0 μ M, 9.9 μ M, 14.9 μ M and 19.9 μ M netropsin. The maximum intensity of emission was recorded for each trial, and these values were used to calculate a rate constant for netropsin binding. An average k_q of $3.12 \times 10^{11} \text{ M}^{-1} \text{ s}^{-1}$ was found. In addition, netropsin binding to 10-base pair ds-DNA oligos containing fluorescent 2-aminopurine was observed using similar conditions. Binding of netropsin was less apparent in these studies. Current goals include monitoring binding of netropsin to ss-DNA oligos.

A METHOD OF CONSTRUCTING DEMOGRAPHIC PROFILES FOR FRANCHISES BASED ON THE DEMOGRAPHIC PROFILES OF SUCCESSFUL COMPETITORS

Erik B. Draxten

University of St. Thomas, St. Paul, MN

This study uses GIS to analyze potential locations for a certain franchise of a high-quality fast food restaurant in the Twin Cities metro. Currently, there are two restaurants in the Twin Cities under construction, but the firm plans to open more. No customer data is available from the two existing Twin City franchises, so the demographic profile for a successful franchise is unknown. This particular franchise competes head-to-head with a second franchise. The products, marketing, and overall business plan of the two franchises is almost exactly the same. It is known that three of the competing franchise restaurants have the highest sales of all of those franchises, nationwide. Therefore, this study uses the following procedure. Drive-time polygons are used to estimate the trade area of the three successful competitor locations. These trade-area polygons are then intersected with census block groups. The result is that the demographic profile can be constructed for the three successful competitors. That profile can then be assumed to be the same profile as for the first franchise. Then, the GIS database can be searched for those characteristics. Promising locations included

areas with a high population of college-aged people, and with complimentary businesses nearby.

IDENTIFICATION OF A POTENTIAL MINIMAL PROMOTER SEGMENT REQUIRED FOR THE EXPRESSION OF THE HUMAN PROSTATE-SPECIFIC HOMEBOX GENE, NKX3.1

Stephen Evelsizer

Bethel College, St. Paul, MN

A eukaryotic gene is only expressed when transcription factors and RNA polymerase are acting in concert with the gene's promoter sequences. While potentially there are other sequences, such as enhancers, that might assist in the maximal expression of the gene, it is the promoter elements that are most critical of the DNA sequences. NKX3.1 is a homeobox gene hypothesized to be involved in the human male prostate development and may be implicated in prostate cancer. Accumulating evidence suggests that the gene is expressed almost exclusively in the prostate. Previous research has shown that significant expression and prostate-specificity of the NKX3.1 gene can be achieved with as little as approximately 500 bp of the promoter region. This research dissected the promoter region even further. Promoter segments shorter than 500 bp (approximately 250 and 140 bp) were generated and ligated to a reporter firefly luciferase gene. The level of expression of luciferase driven by the promoter region was determined following transfection into two cell lines: LNCaP, a human prostate cell line, and HEK293, a human embryonic kidney cell line. This research suggested that as little as 140 bp of the NKX3.1 promoter region may be necessary to confer tissue-specific expression of this gene. The implications of these results will be discussed.

EXAMINING THE ROLE OF TWO CO-PURIFYING PROTEINS ON SEA URCHIN MICROTUBULE ASSEMBLY

Mario Fernandez and Ellen Brisch

Minnesota State University, Moorhead, MN

The formation of the mitotic spindle is a critical event required for cell division. The mitotic spindle is responsible for aligning the newly replicated chromosomes during metaphase and rapidly and accurately segregating them to the poles of the daughter cells. In order for the mitotic spindle to form, changes in Microtubule (MT) assembly and dynamics must occur. The regulation of MT assembly is controlled in part by phosphorylation/dephosphorylation of Microtubule Associated Proteins (MAPs) and other MT co-purifying proteins. Previously, 44 kD and 48 kD proteins were identified as targets for phosphorylation/dephosphorylation regulation of Sea

Urchin Microtubule Protein assembly. These experiments utilized Okadaic Acid (OA), a potent phosphatase inhibitor in combined MT length and MT kinase assays to identify the 44 kD and 48 kD proteins. Currently we are using a western blot approach to identify these proteins. Based on molecular weight similarity we have begun our studies by investigating a MAPK/ERK family member as a candidate for the 44 kD phosphatase sensitive MT co-purifying protein. Our results demonstrate that MAPK/ERK does co-purify with MTs through repeated rounds of assembly and disassembly, however active (phosphorylated) MAPK/ERK is detected in early purification cycles only. We are currently using OA in dephosphorylation block experiments to investigate these results further, specifically to examine if the 44kD phosphatase sensitive protein is in fact a MAP/ERK kinase family member.

VISUAL COMMUNICATION OF PREDATION THREAT INDUCED BY ALARM PHEROMONE IN FATHEAD MINNOWS, *Pimephales promelas* (CYPRINIDAE)

Casey Godwin and Andy McCollum

Cornell College, Mount Vernon, IA

Numerous species of fishes from multiple orders produce and recognize chemical alarm signals. In Ostariophysan fishes, the alarm substance originates in epidermal cells and is released when their skin is damaged. Recent publications have explored this mechanism and have proposed explanations for the evolution of a seemingly altruistic trait. Fathead minnows (*Pimephales promelas*) respond strongly to alarm pheromones released from conspecifics by increasing shoal coordination, seeking cover, decreasing foraging, and remaining motionless. Naïve fathead minnows learn to recognize a novel predator's scent from experienced fish. This case of visual and chemical communication of threat suggests that fish may be able to perceive a threat using visual cues alone. Fish that have not been reached by the dispersion of the alarm chemical may benefit by recognizing the reactions of other fish in the scent area and respond accordingly. We asked whether fathead minnows can perceive a threat by simply observing conspecifics who are exposed to the alarm substance. We exposed groups of fathead minnows to skin extract containing the alarm pheromone and observed the responses of fish in adjacent aquaria to determine whether this second group of fish perceived the threat that was presented to the adjacent fish.

TESTING CHEMICAL STABILITY OF PREY ALARM / PREDATOR ATTRACTANT CUE

Jill Greenley, Brooks Angell, Brian Wisenden
Minnesota State University, Moorhead, MN

Aquatic animals use publicly available chemical information for assessment of predation risk. Chemical cues released from injured tissues when a member of their own species has been attacked is a reliable indicator of the presence of predation risk. It also a chemical advertisement to other predators that there is an opportunity to pirate a meal. As such, chemical alarm cues serve also as chemical predator attractants. To develop an attractant for commercial purposes, the chemical must be stable enough to be rendered to a dry state and applied into fishing lure technology. Here, we test the efficacy of lyophilised (freeze-dried) skin extract to elicit alarm responses from zebra danios. This is the first step toward developing a commercially viable product.

A RESEARCH PROPOSAL: FACTORS INFLUENCING SUCCESSFUL TURKEY (*Meleagris gallopavo*) REINTRODUCTION IN NORTHWESTERN MINNESOTA

Natasha W. Gruber, Katie R. Geray, Tracy Mastel, and Donna Bruns Stockrahm
Minnesota State University, Moorhead, MN

The Minnesota Department of Natural Resources (DNR) is currently working on a wild turkey (*Meleagris gallopavo*) reintroduction program in northwestern Minnesota. We are working with the DNR to conduct a survey of local residents about turkey sightings in this region. Field observations will also be used to observe the success of wild turkeys. We will be collecting data by distributing surveys to local landowners within a fifteen-mile radius of the Red River. The surveys will aid in collecting data on turkey locations and their habitat use, approximating the number of turkeys in this area, and their survival rate in northwestern Minnesota's winter climate. This study will ultimately aid the DNR wild turkey reintroduction plan and help them to evaluate the possibility of implementing a wild turkey hunting season around the area of Moorhead, Minnesota.

WOUND REPAIR AND MAPK RESPONSE TO LPA, PE, AND uPA IN NORMAL AND CANCEROUS HUMAN LUNG CELLS

Lisa Hansen, Andy McCoy, Justin Voog, Mark Wallert and Joseph Provost
Minnesota State University, Moorhead, MN

The Mitogen Activated Protein Kinase (MAPK) cascade is involved in a number of cellular processes including protein transcription and pH regulation via the Sodium Hydrogen Exchanger (NHE). These processes are vital for normal cellular growth and proliferation. Here we document the differences

between cancerous and non-cancerous cell lines in their MAPK activation due to urokinase-type plasminogen activator (uPA), lysophosphatidic acid (LPA), and phenylephrine (PE). Using western blot techniques MRC-5 (non-cancerous) cells were shown to exhibit high basal MAPK activity and peak responses to LPA and PE at 50uM. NCI-H196 (cancerous) cells exhibited similar basal MAPK levels in relation to MRC-5 cells, but displayed a heightened response to both LPA and PE. NCI-H23 cells (cancerous) exhibited almost no response to added LPA and a delayed response when incubated with uPA. This may be due to a lack of LPA receptors in the NCI-H23 cell line. We will also determine the ability of individual cell lines to respond to hormone stimulation by increasing their growth rate and wound repair by scratch assay.

THE ROLE OF PKC IN ALPHA-1-ADRENERGIC ACTIVATION OF ERK AND NHE IN CCL39 FIBROBLASTS

Lisa Hansen, Heidi Boyum, Hillary Thronson, Joseph Provost and Mark Wallert
Minnesota State University, Moorhead, MN

The activation of the conventional isoforms of protein kinase C (PKC) by alpha-1-adrenergic receptors is well known. However, the role of PKC in regulating intracellular pH is not clear and is likely to differ with cell type. We have shown that phenylephrine (PE) activation of NHE requires ERK activity. The mechanism for PKC activation of ERK is thought to be mediated by a soluble tyrosine kinase, the serine kinase Raf or another mechanism. Alternatively, there are putative phosphorylation sites on the carboxyl terminus of NHE. In this study, we examined the role of PKC in ERK and NHE activation in CCL39 fibroblasts stimulated with PE. Addition of PMA leads to a robust increase in both phosphorylation of ERK and activation of NHE. Chronic stimulation with phorbol esters abolished the ability of PE to activate ERK or NHE. In a likewise fashion, pre-incubation of the cells with PKC inhibitors, Ro31-8220 or bisindolymaleide-1, significantly blocked PE-induced activation of ERK and NHE. To determine which conventional isoform of PKC is involved, EGFP-PKC alpha, beta-1, beta-2 and gamma fusion proteins were transiently transfected and monitored for intracellular location following phorbol ester and PE stimulation. Addition of PMA induced the translocation of both PKC alpha and PKC gamma, but only PKC alpha translocated after incubation with PE. This was also observed by monitoring the translocation of endogenous PKC alpha to the membrane fractions. Further evidence for a role of PKC in regulation of intracellular homeostasis was determined by exogenous expression of dominant negative alleles of PKC. These data suggest that the conventional isoforms of PKC are involved in the ERK mediated activation of NHE by

the alpha-1-adrenergic receptor. This work was supported by a grant from NSF (MCB-0088654 and DBI-0115927).

**PHOSPHO-REGULATION OF
PYRUVATE, ORTHOPHOSPHATE DIKINASE IN
DEVELOPING RICE SEEDS**

Jarrold Heck and Chris Chastain

Minnesota State University, Moorhead, MN

In C4-plants, PPDK has the well-known role of regenerating the primary CO₂-receptor, PEP, in mesophyll chloroplasts. As with other C4 enzymes, PPDK is subject to light/dark regulation. PPDK Regulatory Protein (RP) confers this regulation. RP is a unique bifunctional "converter" enzyme that inactivates/activates C4-PPDK by reversible phosphorylation of an active-site Thr. Recently, we demonstrated that PPDK in chloroplasts of C3-plants, although non-photosynthetic, undergoes the same light/dark dependent mediated reversible phosphorylation. In this poster, we show that "C3"-RP also has an apparent role in regulating PPDK activity during seed development, where it is an abundant enzyme. In a study of maturing rice grains, we observed that PPDK undergoes a rapid phosphorylation/inactivation at 10 days post-pollination, with time-dependent accumulation of phosphorylated PPDK correlating with seed-weight gain. Associated with PPDK phosphorylation is an extractable ADP-dependent/PPDK-phosphorylating activity in immature seeds. Hence, this putative ancestral "C3"-RP isoform is capable of conferring both diurnal and developmental regulation on its target enzyme.

**THE ACTIVITY AND REGULATORY PROCESSES OF
THE FOXO3A TRANSCRIPTION FACTOR IN RELATION
TO OXIDATIVE STRESS.**

Jessica Heck, Jennifer Dale, Kimberly Mulder and Michelle Mallot

Minnesota State University, Moorhead, MN

The FOXO family of proteins has been recognized as critical to cellular processes such as development, cell division and apoptosis. As a result, these proteins play a pivotal role in the regulation of cellular differentiation and cell proliferation, both during development and in adult. FOXO3a is thought to regulate expression of genes involved in both the cell cycle and apoptosis as this protein is part of the phosphoinositide-3-kinase (PI3-K) signal transduction pathway and is also thought to induce a program of gene expression that allows for the repair of DNA damage caused by ROS. Interestingly, the capacity cells have to repair DNA damaged by oxidative stress from reactive oxygen species (ROS) correlates to increased longevity. This apparent opposing action of

FOXO3a in signal transduction pathways involved in cellular proliferation and in pathways that provide protection against ROS-induced damage may outline a system that provides checks and balances for coupling cell-cycle regulation and apoptosis. Our research aims to examine the molecular link between FOXO3a phosphorylation in response to ultra-violet (UV) radiation, a form of oxidative stress, and apoptosis in Chinese hamster lung fibroblasts (CCL39). Our data indicate that FOXO3a is phosphorylated on Thr32 in response to UV and we hypothesize that this phosphorylation may in part, be due to the activation of the p38MAPK pathway. Since FOXO3a phosphorylation is known to be part of an anti-apoptotic PI3-K pathway we are interested in understanding the relationship between the observed FOXO3a phosphorylation and cell survival.

**PRECIPITATION VERIFICATION OF THE LAPS STORM
TOTAL PRECIPITATION ESTIMATES**

Amy Henry

St. Cloud State University, St. Cloud, MN

A statistical error analysis is performed in order to verify the accuracy of the Local Analysis and Prediction System (LAPS) storm total precipitation (STP) estimates. The analyzed STP estimates from LAPS were compared to cooperative observer and automated precipitation reports throughout the Minneapolis (MPX) county warning area (CWA) at the National Weather Service office located in Chanhassen, Minnesota. LAPS integrates WSR-88D Doppler radar data, aircraft observations, satellite data, and surface observations to produce its analyzed precipitation accumulations. LAPS images, and cooperative observer and automated reports were collected for precipitation cases throughout the winter of 2002 to 2003 for the MPX CWA. With the results of the statistical error analysis, forecasters at the National Weather Service office in Chanhassen, Minnesota will be able to determine if the LAPS STP is a reliable source to use for their forecasts during the winter season.

**SMOKE AND MIRRORS: GETTING THE MOST OUT OF
YOUR BUDGET LASER PROJECTOR**

Jemimah Hendry

Macalester College, St. Paul, MN

Laser projection is a fascinating hobby, but the cost of high-quality laser scanning hardware and software is prohibitive. Consumer-grade laser scanners are much cheaper, but the hobbyist must provide his or her own hardware drivers and image design software. Because of extreme performance limitations, building an effective image design tool for an inexpensive scanner is a challenging task. This paper describes the design and implementation of hardware and software

for an inexpensive laser projector. It also discusses a preemptive algorithm for addressing performance issues in software, as opposed to traditional hardware feedback solutions. My project allows a user to create images and project them onto a screen or wall using two lasers and four mirrors. The measure of its success is based on two properties: minimizing distortion of the projected image, and maximizing the drawing speed of the laser so the projected image does not flicker. Moderate success was achieved for projecting short text messages such as the words "hello world" and for displaying simple graphics such as a "smiley face." The main result of my work is to demonstrate that low cost laser projectors can be constructed for less than one-tenth the cost of professional systems. The hardware is uncomplicated enough that any first year electronics student can build it, and my image design software will be made freely available to the public via the web. This could make the field of laser projection, like photography and ham radio, much more accessible to amateurs.

THE EFFECT OF ULTRA VIOLET RADIATION OF FKHR-L1 PROTEIN IN YEAST

Amanda Hillman and Anojinie Nagahawatte
Minnesota State University, Moorhead, MN

FKHRL1 is a transcription factor, which is a protein involved in binding to and regulating DNA expression. FKHRL1 belongs to the FOXO family of Forkhead transcription factors, which are involved in controlling the cell cycle, cell death, cell metabolism and cellular response to oxidative stress. These pathways seem to be conserved throughout evolution as they use similar mechanisms and proteins in variety of organisms, such as *Mus musculus*, *C. elegans* and *Xenopus*. *S. cerevisiae* is a simple eukaryotic organism that is widely used in experiments that study regulation and mechanisms of cell cycle, cell death and other key processes. Thus we hypothesize that *S. cerevisiae* will contain a homologue of human FKHRL1. Our experiments are designed to examine whether *S. cerevisiae* contains a human FKHRL1 homologue and if so, if its regulation is similar to that in humans. To test our hypothesis, we are purifying protein extracts from yeast cells. We are using extracts in combination with specific human antibodies (anti-FKHRL1) in a western blot assay. If our experiments are successful, yeast can be used as model organism for studying human FKHRL1.

THERMAL EFFECTS OF THE TWIN CITIES URBAN HEAT ISLAND

Paul M. Iniguez
St. Cloud State University, St. Cloud, MN

As the population of the United States increases, urban sprawl of major metropolitan areas

will continue to create a larger and larger impact on the surrounding environment. One aspect in which an urban area largely affects the local area is in the production of an Urban Heat Island (UHI). Studies have shown that temperatures in the core of a metropolitan region can be elevated by as much as six degrees Fahrenheit. With a population of over 2.6 million people, the Minneapolis-St. Paul metro area can have a pronounced effect on the local weather. Temperature data consisting of maximum and minimum temperatures were obtained through the National Weather Service's Cooperative Observer Network. Twenty stations were selected to represent the Minneapolis-St. Paul metro area and the surrounding rural area. The data was carefully analyzed for the years 2000 through 2002, specifically the months of January and July. The resulting data was plotted and analyzed to produce maps depicting the Urban Heat Island of the Minneapolis-St. Paul metropolitan area. The strength of the UHI varies from only a few degrees Fahrenheit during the month of January, to over five degrees Fahrenheit during the month of July.

EVALUATING THE USE OF "GUILLOTINE IMAGING" TO STUDY AXIAL SEGREGATION IN MIXTURES OF GRANULAR MATERIALS IN DRUM MIXERS

Nathan Jensen, Rachel Amantis, Dr. James Flaten
Luther College, Decorah, Iowa

Two-component mixtures of granular materials often segregate axially when rolled in a horizontal drum mixer. This striking phenomenon appears from the surface to consist of alternating single-species bands along the axis of the mixer that evolve over the course of a few hundred revolutions. Subsurface imaging of such mixtures shows that this "axial" segregation is preceded by radial segregation that is not apparent from the surface. Even in fully-segregated patterns, there remain subsurface connections between what appear to be isolated surface bands. The ability to do subsurface imaging is crucial to fully understand segregation in drum mixers. Magnetic resonance imaging (MRI) has proved useful in studying subsurface patterns, but only a limited number of granular materials have appropriate MR signatures. Also, MRI is very expensive. We have developed an inexpensive mechanical procedure called "guillotine imaging" to cut into mixtures with a transparent blade, thereby exposing subsurface patterns. Guillotine imaging is somewhat invasive, but in fact does not significantly distort the patterns under study. This poster will present the results of study done using MRI to document the accuracy of guillotine imaging. We conclude that guillotine imaging is quite benign and thus provides a low-cost alternative to MRI that can be used to study segregation in a much broader array of granular materials.

IS MITOCHONDRIAL INHERITANCE TISSUE SPECIFIC? A NEW LOOK AT THE mtDNA DOGMA FROM A CELL BIOLOGY PERSPECTIVE.

Heidi Jo Johnson, Austin McCoy, Jen Risan and Ellen Brisch

Minnesota State University, Moorhead, MN

Mitochondria play critical roles in the generation of metabolic energy (ATP) in eukaryotic cells. ATP is essential in driving many of the reactions that take place in the body. The role of a mitochondrion is to maximize and control the production of ATP. Furthermore, these cytoplasmic organelles make their own circular DNA, which is referred to as mitochondrial DNA (mtDNA). It is important to note that there is a distinction between nuclear DNA and mtDNA. While nuclear DNA encodes most of the proteins that drive mitochondrial processes, some critical ATP-producing enzymes are encoded by the mitochondrial genome. Mitochondria are extremely important to study because almost any mutation in mtDNA leaves an organism somewhat debilitated. Mitochondria have been thought to be maternally inherited for over twenty years. Evidence from these experiments shows that a child's mtDNA will be identical to that of the mother. Does this mean that there is no paternally inherited mtDNA? Maybe not. Researchers have mainly focused on testing mtDNA in blood samples and have not tested other tissues in the body to determine if these are maternally inherited also. Our approach to investigating mitochondrial inheritance is to find out if it is tissue specific. Initially to test this, we are planning to sequence the mtDNA taken from two different strains of mice. Next, we plan to cross our parent mice and sequence the mtDNA of their offspring. We will be sequencing mtDNA from the blood and also from the muscle to see if mtDNA inheritance is, indeed, tissue specific. Finding out if mitochondrial inheritance is tissue specific is an important step for figuring out what cellular mechanisms are required to direct the mitochondria into different tissues. This may open up a whole new way of looking at mitochondrial inheritance and ultimately show us how this system is regulated.

Kinetic Impact of Point mutated Val-86 to Lysine in Glyoxysomal Malate

VISUALIZING MITOCHONDRIAL DYNAMICS DURING THE CELL CYCLE IN YEAST

Heidi Jo Johnson, Austin McCoy, Jen Risan and Ellen Brisch

Minnesota State University, Moorhead, MN

Mitochondria function to provide cells with energy for all metabolic processes. Throughout the cell cycle, mitochondria are highly dynamic. They continuously move about and change shape depending on which stage of the cell cycle they are in. This process is termed mitochondrial dynamics. In

Saccharomyces cerevisiae, the inheritance of mitochondria from mother cell to daughter bud during cell division is an essential feature of yeast cell growth. The analysis of mutants defective in mitochondrial morphology and inheritance has led to the identification of some of the proteins that control mitochondrial dynamics. Classically, temperature sensitive yeast mutants were used to identify cell cycle regulatory proteins. The analysis of mutants defective in events such as bud formation, DNA synthesis, spindle pole body duplication, and cytokinesis lead to the identification of proteins that control each of these integral steps in cell division. It is our hypothesis, that molecules that control cell division and cell cycle regulation play a key role in mitochondrial dynamics. We are currently testing our hypothesis by examining the following cell cycle mutants for defects in mitochondrial dynamics: *cdc13*, *cdc14*--meiosis and sporulation, *cdc5*, *cdc7*, *cdc15*--kinases, *cdc2*, *cdc6*, *cdc9*--DNA replication. We are visualizing mitochondria using specific dyes and fluorescence microscopy. By identifying cell cycle mutants with mitochondrial defects we can build a model for how mitochondrial dynamics are coordinated during the cell cycle.

DISPARITY OF ERK ACTIVATION IN CHINESE HAMSTER LUNG (CCL39) CELLS BY PRIMARY AND SECONDARY ALCOHOLS.

Jessica F. Johnson, Rachel L. Sang, JaDean J. Anderson, Mark A. Wallert, and Joseph J. Provost.
Minnesota State University, Moorhead, MN

Serum, growth factors, and lysophosphatidic acid activate the Na^+-H^+ exchanger (NHE) in Chinese hamster lung cells (CCL39). Recently, our laboratory reported that the adrenergic agonist phenylephrine (PE) activates NHE through an ERK-dependant pathway. We believe that PE stimulation involves several intermediates in the regulation of NHE. One pathway involves the activation of Phospholipase CB, Protein Kinase C, Raf-1, MEK and Erk. A second potential pathway involves the PKC-mediated activation of Phospholipase D (PLD). We also believe that LPA activates Erk through the intermediates RhoA and PLD. PLD converts phosphatidylcholine to choline and phosphatidic acid. In some cell types, phosphatidic acid leads to the activation of the Ras-Erk pathway directly or by activating another isoform of PKC that can phosphorylate Raf, MEK, or Erk. The goal of our experiments is to verify the involvement of PLD in the activation of Erk and NHE. The involvement of PLD in Erk activation was tested by the addition of the primary alcohols butanol and ethanol to cells. In the presence of ethanol and butanol Erk activation by PE was completely blocked and LPA activation of Erk was dramatically reduced. Three proteins are primarily involved in the regulation of stress fiber formation and

cell migration. They are Erk, RhoA and NHE1. Since PLD regulated the activation of Erk and NHE1 in CCL39 cells we believe it may also be involved in controlling formation of stress fibers. To determine this involvement, the ability of CCL39 cells to form stress fibers in the presence of butanol will be measured. Additionally, a role for PLD in cell migration will be examined using a wound assay where the rate of cell migration into a wounded area is measured. If PLD plays a part in stress fiber formation, the cell's rate of migration will be reduced.

**THE EFFECTS OF COMMERCIALY AVAILABLE
Echinacea purpurea ON MACROPHAGE
ACTIVATION AND PHAGOCYTOSIS.**

Jessica Marie Johnson

St. Mary's University of Minnesota, Winona, MN

This experiment determined whether macrophages treated with *Echinacea purpurea* exhibited an increase in phagocytic activity. This was done by exposing RAW 264.7 cells to different concentrations of commercial *Echinacea*. The treated cells were incubated with the bacteria, *Staphylococcus aureus*. The macrophages were examined microscopically in order to determine the difference, if any, in phagocytic activity of macrophages treated with, or without, *Echinacea*. The remainder of the samples were plated on agar and incubated overnight as another method of determining the amount of remaining live bacteria. At this point it is apparent that *Echinacea* has effects on the morphology of macrophages. *Echinacea* is a wildflower that is native to North America. Its roots and above-ground vascular tissues have been used medicinally. *Echinacea* is one of the most scientifically studied of all herbs. Previous studies have shown that polysaccharides present in the herb bolster the immune system in many ways (Bone, 1997). The polysaccharides increase the number of white blood cells and increase the number of lymphocytes in animals. Also, these polysaccharides increase activity in macrophages, which is an important immune response (Rininger, Kickner, McLean, 2001). As mentioned, the purified polysaccharides found in *Echinacea* exhibit effects on the immune system. Studies have not been completed on the commercially available *Echinacea*'s affect on phagocytosis.

**EXPLORATION OF CHROMATOGRAPHIC RESOLUTION
DUE TO THE EFFECT OF INJECTION PULSE DURATION**

Melissa A. Jones, Jonathan M. Maurer, Tyler Vanaduronvan, Anthony Borgerding
University of St. Thomas, St. Paul, MN

A method was developed to study the effect of injection pulse duration on chromatographic resolution. Using LabView software, a program was written to control a high-speed injector. The program sent pulses

to open and shut a loop injector with a high-speed actuator, resulting in injection pulses between 1-50 msec being delivered to a GC column. The GC was installed with a short (~2 meter) column, allowing mixtures of five to ten volatile organic compounds to be separated in as little as 5 seconds. With the faster injection pulses, better resolution of the chromatographic peaks was attained. Though the resolution improved with faster pulses, the limits of detection were worse due to less volume of the solutions being injected.

**USE OF MICROSATELLITES FOR ASSESSING
REPRODUCTIVE SUCCESS IN FATHEAD MINNOWS
(*Pimephales promelas*).**

Justin Klitzke, Jason Brown and Michelle Malott
Minnesota State University, Moorhead, MN

The development of new DNA technologies has increased the opportunities to study genetic variation in populations. The genetic composition of a population can also be used to show reproductive success by tracing lineage. As a result of sexual reproduction, roughly half the genetic material in an individual comes from each parent; the offspring can then be linked to each parent based on their genetic makeup. In most populations each individual (unless clones) is genetically unique. This genetic uniqueness results from slight differences in DNA, these differences can be used as a genetic fingerprint to study lineage. Since most species share 99.9% of their DNA, the regions of the genome that contain the highest level of variation would be the most useful in resolving genetic fingerprints. Microsatellite DNA loci have among the highest levels of variation within most eukaryotic genomes, making them suitable for creating distinct genetic fingerprints. Microsatellites are short repetitive sequences that are highly polymorphic; these sequences can be isolated from the genome using PCR (Polymerase Chain Reaction), a method of DNA amplification. In this study we have developed a method for using microsatellites to analyze reproductive lineages and behavior in fathead minnows. Ultimately we will use these same techniques to examine breeding parasitism of Golden Shiners (*Notemigonus crysoleucas*) on Pumpkinseed Sunfish (*Lepomis gibbosus*). In this study we describe the general characteristics of using microsatellite DNA loci, the isolation (DNA from fins, fry, and eggs), viewing amplified microsatellites, and how to analyze data using fathead minnows (*Pimephales promelas*) as a focal species.

PHOTIC RESPONSIVENESS OF THE CIRCADIAN PACEMAKER IN STEADY-STATE AND NON-STEADY-STATE CONDITIONS

A.J. Langseth, L.S. McNamara, L.N. Tracy, P.A. Stahler, K.G. Anderson, and D.E. Nelson
University of St. Thomas, St. Paul, MN

In mammals, a pacemaker within the hypothalamic suprachiasmatic nucleus (SCN) drives circadian rhythms of behavior and physiology. A specialized retino-hypothalamic tract provides photic information needed for synchronization or entrainment to environmental light-dark (LD) cycles. Studies have examined this system in both steady-state conditions (extended constant darkness (DD) allowing the endogenous pacemaker to express a stable period) and immediately following a lighting transition (such as LD to DD). We have quantified the influence of such transitions upon the circadian photic entrainment pathway in mice. Animals were entrained to LD 12:12 and then maintained in DD for durations of 4h-316h. A single light stimulus (15min, 500lux) was delivered to each mouse at circadian time 16 (~4h after activity onset) after a specific duration in DD. Light-induced phase delays of activity rhythms were measured for each mouse. Within 28h of the transition to DD, delay magnitudes increased from 36 ± 10 min (mean \pm SEM) to 63 ± 13 min (at 4 and 28h, respectively). From 52-316h there were smaller increases in responsiveness and delays reached a maximum of 110 ± 7 min by 316h. Following LD 12.75:12.75 there appeared to be a significant "lag" in the growth of photic responsiveness. Delays remained small at 4 and 28h (3 ± 12 min; 1 ± 18 min) and then the responsiveness increased over 28-316h in a manner very similar to that observed following 24h LD. These data provide interesting comparisons between photic responsiveness measured in steady-state and non-steady-state conditions and may provide an insight into changes observed in the circadian resetting mechanism immediately following entrainment to environmental light cycles.

THE ROLE OF PORPHYRIN-LIKE LIGANDS ON DAMAGED DNA

Tammy J. Lien, Jill A. Moes
Minnesota State University, Moorhead, MN

Radiation damage to DNA is of interest from a purely mechanistic point of view and also because it is thought to play a major role in cellular damage, including cell death. Exposure of frozen aqueous DNA to gamma radiation at 77K resulted in the formation of guanine radical cations and thymine radical anions or cytosine radical anions. In this study we present an EPR investigation of the yields of free radicals, guanine and thymine and/or cytosine, formed in gamma irradiated frozen DNA in the presence and

absence of a porphyrin-like ligand, as a potential radical protector/protector.

STRESS FIBER FORMATION DUE TO THE PHENYLEPHRINE REQUIRES THE ACTIVATION OF ERK, THE PKC-DEPENDENT SMALL G-PROTEIN RHOA, AND AN INCREASE IN CELLULAR PH

Andy McCoy, Justin Voog, Joseph Provost and Mark Wallert
Minnesota State University, Moorhead, MN

Stress fiber formation in Chinese hamster lung fibroblasts (CCL39) requires both RhoA and NHE. We have recently demonstrated that ERK and NHE are activated in response to the $\alpha 1$ -adrenergic agonist Phenylephrine (PE). This activation was blocked by the MEK inhibitor PD98059 and by the Rock inhibitor Y27632. We have also shown that RhoA activation is blocked when cells are treated with PKC inhibitor. This suggests that RhoA is stimulated in a PKC dependent manner. Finding a second G-protein coupled pathway that activates both RhoA and NHE led us to investigate the ability of PE to stimulate stress fiber formation. Incubation of CCL39 cells with 50 – 100 mM PE for 15 minutes induced the formation of stress fibers. This formation was blocked in the presence of PD98059 or Y27632. To verify the ability of PE to activate RhoA, EGFP-tagged RhoA was used to observe translocation. Control cells displayed RhoA dispersed throughout the cytoplasm, while PE stimulated cells showed RhoA predominantly associated with the plasma membrane. To determine the requirement for NHE in stress fiber formation, PS120 cells were used. PS120 cells are Chinese hamster lung fibroblasts that do not express NHE. PS120 cells incubated with PE did not show stress fiber formation. If these cells were treated with trimethylammonium (TMA) chloride at the same time as PE stimulation stress fibers did form. The addition of 20 mM TMA increases intracellular pH by approximately 0.25 pH units, a value similar to PE addition. This data indicates that cells require NHE to increase pHi in order to form stress fibers. Cumulatively, these data show that PE induced stress fiber formation in CCL39 cells requires ERK, RhoA and NHE activation. The physiological role of the $\alpha 1$ -adrenergic receptor stimulation in stress fiber formation is still uncertain.

VIENNA CONSULAR TREATY OBLIGATIONS: THE CONSEQUENCES OF U.S. NON-COMPLIANCE

Roland D. McKay
Macalester College, St. Paul, MN

Why does the United States often fail to comply with key provisions of the Vienna Convention on Consular Relations (1963)? By not informing detained foreign nationals of their right to consular access and/or failing to notify the national's consulate

of his/her detention, the U.S. is not meeting its treaty obligations. The detail of these failures can be captured in the nature of communication and cooperation between U.S. federal and state governments and foreign consulates in relation to the treaty. By examining individual domestic and international court cases brought by foreign governments against the United States and interviewing dozens of detained foreign nationals, consular officials, attorneys, and immigration and law enforcement authorities, I attempt at a clear understanding of the process and its broader implications for the United States and the normative dimensions of international law. Due to the reciprocal nature of international law, and consular relations specifically, the consequences of continued U.S. non-compliance threaten the integrity of foreign policy goals and put Americans abroad at increased risk. The results are already being felt: American consular intervention is increasingly difficult and bilateral relations with some key countries have weakened, making agreement on other goals more distant than ever. In the context of the current policy environment, I offer some recommendations for a more efficient treaty-enforcement mechanism, including a more aggressive role for the U.S. State Department and foreign consulates.

INFLUENCE OF CIRCADIAN RHYTHM ON SPATIAL LEARNING

Leo McNamara, Abraham Langseth, Lauren Hruby, Gaby Moon

University of St. Thomas, St. Paul, MN

The Influence of the Circadian Clock on Spatial Learning Leo McNamara, Abraham Langseth, Lauren Hruby, and Gaby Moon Faculty Mentor: Dr. Dwight Nelson Department of Biology, University of St. Thomas, St. Paul, MN 55015 The Morris Water Maze has become a common procedure for assessing spatial learning in mice. Mice in enriched environments show increased neurogenesis and higher rates of spatial learning than mice in non-enriched environments. In addition, mice have a robust circadian rhythm of activity and rest that is synchronized by the light-dark cycle. This experiment was designed to determine whether there is a circadian influence upon spatial learning in mice. Two groups of 12 mice each were trained/tested in the Morris Water Maze; one during the activity phase (night) of their daily cycle, and the other group of mice was tested during their inactive phase (day) phase. Each mouse was given 40 seconds to locate a small platform hidden approximately 1cm beneath the surface of an opaque water pool. Visual symbols were taped to the walls of the testing room to serve as cues for spatial orientation. The duration of each trial, average distance to platform, and total distance traveled were tested for each animal over a period of seven days. Mice in both treatment

groups showed a significant decrease in total distance traveled for each trial and the average distance from the platform for each trial. Therefore both groups demonstrated significant learning over the course of the 14 training sessions. Surprisingly, however, there did not appear to be a significant difference in the learning rates between the two groups. These data suggest that there may not be a significant circadian upon spatial learning rates measured with the Morris Water Maze.

DEVELOPMENTAL AND BEHAVIORAL ONTOGENY OF ANTIPREDATOR BEHAVIOR IN CICHLID LARVAE

Anusha Mishra, Bree Hamann, Ellen Brisch, Brian Wisenden

Minnesota State University, Moorhead, MN

Cichlids are unusual among fishes in having prolonged care of their eggs and developing young for up to 6 weeks. This is an enormous investment because of the energy spent defending the young against predators, lost foraging opportunities, and lost opportunities to reproduce again until the brood of young reaches independence. The duration of brood care is determined by the antipredator competence of the young. Here, we use video playback analysis to measure the speed and distance of the startle response of convict cichlid young at increments of development. We correlate the capacity for behavioral avoidance of predator attack with the degree of calcification of the skeleton. Understanding the relationship between size and antipredator competence will shed light on the evolutionary trade-off between egg size and egg number in resource allocation to reproduction in species with extended parental care.

THE ROLE OF PODOPHYLLOTOXIN ON RADIATION DAMAGE

Jill A. Moes, Tammy J. Lien

Minnesota State University, Moorhead, MN

Exposure of dilute aqueous DNA to ionizing radiation at ambient temperatures result damage to the DNA, major reactions being the addition of OH radicals to DNA bases and abstraction of C-H hydrogen atoms from deoxyribose units. In order to concentrate on direct damage processes, we have studied frozen aqueous solutions using EPR spectroscopy. Exposure of frozen aqueous solutions of DNA to gamma radiation at 77K resulted in the formation of guanine-center radical cations and thymine radical anions or cytosine radical anions. We have also investigated the effects of podophyllotoxin derivative on the formation of the DNA radical centers. Our preliminary results show that in the presence of podophyllotoxin, the rate of formation of primary DNA radicals are decreased.

THE LINK BETWEEN CELL CYCLE REGULATION AND MITOCHONDRIAL INHERITANCE

Anna Naig and Ellen Brisch

Minnesota State University, Moorhead, MN

Mitochondria function to provide cells with energy for all metabolic processes. Throughout the cell cycle, mitochondria are highly dynamic; they continuously move and change shape depending on which stage of the cell cycle they are in. This process of continuous change is termed mitochondrial dynamics. In *Saccharomyces cerevisiae*, a species of budding yeast, the inheritance of mitochondria from mother cell to daughter bud during cell division is an essential feature of yeast cell growth. Without the inheritance of mitochondria from the mother cell, the daughter bud cannot survive. Thus, mitochondrial dynamics is linked either directly or indirectly to genes that regulate the cell cycle. We are interested in understanding how mitochondrial inheritance is coordinated with the cell cycle, in specific, which genes control this process. To determine one or more of the genes that link these two processes, specific mutations in genes that regulate the cell cycle in yeast were generated. This was done by creating a piece of DNA which, when inserted into yeast, will replace a cell cycle gene of choice with an incomplete copy of that particular gene. As a result that particular gene will be inactivated. The yeast cells can then be observed by staining their mitochondria, with a membrane potential dye, DiOC6. Differences in the mitochondria dynamics of mutated yeast will indicate which cell cycle gene is linked to the process of mitochondrial inheritance.

HOW ULTRA-VIOLET LIGHT INFLUENCES THE SUBCELLULAR LOCALIZATION OF THE TRANSCRIPTION FACTOR FOXO3A.

Anna Naig and Michelle Malott

Minnesota State University, Moorhead, MN

The transcription factor FOXO3a has the capability to initiate both programmed cell death and cell survival mechanisms. When the transcription factor is bound to DNA it promotes the transcription of proteins that initiate these cellular processes. To inhibit FOXO3a from promoting transcription it is physically removed from the nucleus when it has been phosphorylated on at least two amino acid residues. It is known that cellular stress, such as UV light, causes apoptosis (programmed cell death) or cell cycle arrest, the latter of which conserves energy and works in conjunction with the cell survival mechanisms. Interestingly, we have observed FOXO3a phosphorylation on Thr32 in Chinese hamster lung fibroblasts (CCL39 cells) after exposure to UV light. As a result, it is probable that following UV exposure, FOXO3a will be in the nucleus of the cell and thus activated. However, it is expected that the majority of FOXO3a would be found in the cytoplasm in response

to UV light due to current hypotheses concerning the behavior of the transcription factor. To determine if FOXO3a is activated in response to UV light, CCL39 cells will be transfected with wild type FOXO3a with a hemagglutinin (HA) tag, and then exposed to UV light. After exposure, the cells will be labeled with anti-HA antibodies conjugated to fluorescein and the cells will be mounted on slides and examined with a fluorescent microscope to determine the location of FOXO3a; either in the nucleus or in the cytoplasm. FOXO3a mutants, which are incapable of phosphorylation, will also be transfected into CCL39 cells. These mutants contain alanines where phosphorylatable amino acids belong; since alanines cannot be phosphorylated those mutated sites are incapable of being phosphorylated. These mutants will be used to determine what regulatory phosphorylation sites on FOXO3a are involved in the translocation after exposure to UV light.

THE EFFECTS OF COLONIZATION OF THE SOYBEAN APHID (*Aphis glycines*) ON DIFFERENT VARIETIES OF SOYBEANS (*Glycine max*)

Meredith Noetzel

University of Minnesota, Morris, MN

The soybean aphid (*Aphis glycines*) is an agricultural pest that has begun to invade soybean (*Glycine max*) fields throughout the United States. This aphid reproduces rapidly, with populations capable of doubling every two to three days under optimal conditions. These aphids have been reported to cause crop damage, reducing yields. No studies have been performed, in the United States, examining the effects of aphid colonization on different soybean varieties. The objectives for the present study were the following: determine varietal differences of soybean aphid colonization, investigating resistance and tolerance; determine if Gaucho® seed treatment affects aphid colonization; and determine differences in seed characteristics, including yield, seed size, protein and oil content. The study was conducted at three locations in central MN with ten soybean varieties. The data were analyzed using repeated measures analysis of variance models using the SAS system. Soybean aphid colonization varied, along with resistance and tolerance, among varieties. MN1302 had the greatest resistance to colonization for the treated varieties, and was colonized least for the untreated varieties. However, Lambert, M94-161045, MN0902CN, He Feng 35, MN0071, and MN0302 did not have a significantly different number of aphids. He Feng 25 had the greatest tolerance to colonization for the untreated varieties. MN0201, He Feng 35, M94-161045, and Hei Lung 37 had the greatest tolerance to colonization for the treated varieties. The levels of colonization were greater on untreated varieties than on

treated, showing that Gaucho® treatment was successful in controlling aphid colonization.

INDOLE DIMERS AS ANTI-TUBERCULAR AGENTS

Wayland E. Noland, Stephen M. Almeida, Michael S. Bagan, Christopher A. Kreyer

University of Minnesota, Minneapolis, MN

Mycobacterium tuberculosis remains a serious illness in much of the developing world. In our research of anti-tubercular compounds we have focused on indole dimers, more specifically 5,5'-dibromo-2,3-dihydro-1H-[2,3'] biindolyl (5-bromoindole dimer) and more recently 5,5'-dichloro-2,3-dihydro-1H-[2,3']biindolyl (dichloro indole dimer). Both compounds have been submitted to the TAACF for testing and the former has shown 100% inhibition against tubercular growth while results for the latter are still pending. We are continuing our research to acylate these dimers with organic acids with value as preservatives, among them sorbic and benzoic acid, to form amide derivatives.

SIGNIFICANT SEVERE THUNDERSTORM PROXIMITY SOUNDINGS

Stephanie M. Nordin, Harold E. Brooks and Jeffrey P. Craven

St. Cloud State University, St. Cloud, MN

Four hundred and sixty-eight 0000 UTC proximity soundings were examined in an attempt to find parameters that may discriminate between significant tornadic and significant non-tornadic environments. Significant severe weather is defined as a storm having an F2 or greater tornado, 2.00 inch hail or greater, and/or 65 knot wind speeds or greater. The data set was constructed between the dates of September of 1993 through December of 1996 for the contiguous United States region. In this study, proximity is defined as a significant severe weather event that occurred within 100 nm of a United States rawinsonde site, and between 2100 UTC and 0300 UTC (six hour time period centered on 0000 UTC launch). It was shown that low-level shear and mean layer lifting condensation level heights were the best discriminators between these two types of environments.

THE RELATIONSHIP BETWEEN MONETARY POLICY, AGGREGATE LIQUIDITY, AND MARKET VOLATILITY: A THEORETICAL AND EMPIRICAL INVESTIGATION

Jason Park

Carleton College, Northfield, MN

This paper examines the effect of Fed policy on stock and bond market liquidity over the 1992-2000 period. Although it is difficult to characterize the overall impact of the Fed on market liquidity, I construct a set of hypotheses to develop a theoretical

framework in order to explain the effects observed in this study. By analyzing the impact of FOMC meetings on bid-ask spreads, I find that movements in liquidity are induced by adverse selection costs, investor expectations of policy actions, and expansionary monetary policy. During crisis periods, the presence of an FOMC meeting on a trading day has a significant impact on bond liquidity. Furthermore, investor expectations seem to play a key role in determining liquidity patterns in both markets during crisis periods. By aggregating data to obtain weekly observations, I find that money supply expansions serve to enhance stock market liquidity. Ultimately, this study sheds light on the importance of Fed action, and establishes a theoretical basis for explaining Fed-induced movements in stock and bond liquidity. Further developments in this area may help the Fed determine its policy actions, and effectively manage the resulting impact of its decisions in the financial markets.

EPR STUDIES OF NITROXIDE FREE RADICALS IN LIVING MICE

Moh Pezeshk, Derick Dalhouse, and A. Pezeshk

Minnesota State University, Moorhead, MN

The time course reduction of two nitroxide free radicals were investigated in living mice using EPR spectroscopy. In this experiment, we monitored the in vivo reductions of a water soluble and a lipid soluble nitroxides injected in a mouse vein, by sampling the distal portion of its tail in the EPR cavity. The lipid soluble nitroxide has the advantage of permeability into membrane and thus could provide important information on redox reaction within the membrane. Our preliminary real-time in vivo results show that in both cases, the accumulation of the free radical after administration of the nitroxide was rapid, reaching a maximum value after injection, followed by a steady decrease. The decrease in the tail blood EPR signal intensity is due to bioreduction of the nitroxide radicals by reducing agents.

CHARACTERIZING THE TRANSIENT MOTION OF CHARGE CARRIERS IN GALLIUM ARSENIDE ON ULTRAFAST TIME SCALES.

Alexander Reinhardt

Macalester College, St. Paul, MN

The ability to control the motion of electric charge in semiconductors has important applications for the design of smaller and faster integrated circuits. We have constructed a system which allows us to characterize the movements of charge carriers in a semiconductor on a time scale of ~1-10 picoseconds. A laser that emits femtosecond pulses was used to hit a semiconductor (GaAs) surface. When the semiconductor is hit by the pulse, it emits THz frequency electromagnetic radiation. It was expected

that that two processes drive the transient currents that produce THz pulses. Both electric fields and diffusion of hot carriers can produce electric currents, and we have designed experiments which can control which effect dominates.

THE INFLUENCE OF ENSO ON THE DYNAMICAL CHARACTERISTICS OF UPPER MIDWESTERN WINTER TEMPERATURES

Angela Rodgers

St. Cloud State University, St. Cloud, MN

Most often, it is assumed that seasonally warm or cold winter temperatures are the effect of El Nino or La Nina. The question is to what extent are the broad generalizations associated with El Nino and La Nina representative of observed day-to-day winter conditions in the upper mid-west. A second question is if the temperature variations in the mid-west exhibit behavior that is more predictable or more chaotic. An analysis of 52 years of daily temperature data from St. Cloud, MN (KSTC) will be presented. Results focusing on persistent and recurrent departures from normal will be emphasized.

SYNTHESIS OF A NEW SPIROINDOLINOBENZOPYRAN PHOTOCROMIC POLYMER

Emily R. Rolfes

University of St. Thomas, St. Paul, MN

A polymerizable monomer was synthesized using a convergent synthesis. A spiroindolinobenzopyran photochromic compound with a carboxylic acid functional group was synthesized in two steps. In addition, a polymerizable cyclic olefin with an alcohol functional group was synthesized in two steps. The two compounds were then coupled to the polymerizable olefin by creating an ester linkage using DCC and DMAP to give a polymerizable photochrome monomer. The monomer was polymerized with a ruthenium-based catalyst by the process of ring-opening metathesis polymerization (ROMP). Characterization of the new photochromic polymer was done using ¹H-NMR and UV-Vis spectroscopy. A UV-Vis spectrophotometer was used to experimentally determine fade time and wavelength of maximum absorption of the colored form. The photochromic monomer had a lambda max of 590 nm while the photochromic polymer had a lambda max of 584 nm. The monomer had a fade time of 8 seconds and the polymer had a fade time of 16 seconds. A new photochromic polymer was successfully synthesized and characterized.

MORTALITY AND SPATIAL DISTRIBUTION OF THE INVASIVE GREEN CRAB, (*Carcinus maenas*): EFFECT OF THE BLUE CRAB

Cecilia A. Scheuerman

University of Minnesota, Twin Cities, Minneapolis MN

In a variety of ecosystems, invasive species produce serious ecological and economic impacts. Understanding current marine invasions and how they are regulated is the most effective way to prevent further invasions in the future. By analyzing a marine species with multiple invasions in a variety of locations, a pattern of ecological constructs can be found to indicate the susceptibility of ecosystems to invasion. The green crab, (*Carcinus maenas*), has a history of invasion and is rapidly developing a global distribution. On the east coast of North America, it is hypothesized that the native blue crab, (*Callinectes sapidus*), regulates the local and regional distribution of the green crab. I tested this hypothesis, in the Great Bay-Mullica river estuary in southern New Jersey, using field data on the relative abundance of blue crabs and green crabs and a tethering experiment to determine the relative mortality of green crabs in areas of varying blue crab abundance. The field sampling, June-August 2002, shows consistent trends of a negative correlation between the abundance of blue crabs and green crabs. Additional sampling (April-August) indicates a temporal shift in green crab habitat use driven by increasing blue crab abundance. In the tethering experiment, green crab mortality increases with escalating blue crab abundance suggesting blue crabs are a significant source of green crab mortality. These data support the hypothesis that blue crabs regulate the local distribution of green crabs and suggest that blue crabs may also regulate the regional distribution of green crabs on the east coast.

COMPARING THE SELECTIVITY OF THE AROMATIC SELECTIVE LASER IONIZATION DETECTOR WITH A PHOTO-IONIZATION DETECTOR FOR ANALYSIS OF VOCs

Gregg Schieffer, Melissa Meyer, and Tony Borgerding

University of St. Thomas, St. Paul, MN

The Aromatic Selective Laser Ionization Detector (ArSLID) is a new detector for gas phase analytes that has recently been developed. It is based on atmospheric pressure resonance enhanced multiphoton ionization, accomplished with a newly developed, inexpensive micro-laser. The ArSLID and the photo-ionization detector (PID) were compared as detectors for fast gas chromatography (GC) by analyzing aromatic volatile organic compounds (benzene, toluene, ethyl benzene, o-xylene, and isopropyl benzene) and a series of non-aromatic organic compounds (methyl tert-butyl ether, methyl cyclohexane, 1-octene, 2-heptanone, heptaldehyde, and 2-octanone). Separations were completed on the order

of tens of seconds for the longest retention time. The PID responds to the non-aromatic organic compounds as well as the aromatic organic compounds whereas the ArSLID responds only to detecting the aromatic organic compounds. Also, data collected from the ArSLID is sensitive to pictogram levels and the ArSLID has a large linear dynamic range.

ECOLOGY OF PAINTED TURTLES (*Chrysemys picta*) IN CLAY COUNTY, MINNESOTA

Joanna M. Schmit and Natasha W. Gruber, Donna M. Bruns Stockrahm and Jerome W. Stockrahm
Minnesota State University, Moorhead, MN

Painted turtles (*Chrysemys picta*) were live-trapped during the summer and early fall of 2001 and 2002 in Clay County, Minnesota, to study growth rates, recapture rates between years, population characteristics, and movements. In 2001, 2 sloughs (< 2 km apart) were trapped, 2.7 ha and 6.2 ha, respectively. In 2002, a third slough (< 1 ha) that was positioned between the first 2 sloughs was added to the study. For each captured turtle, outer scutes were notched for individual identification. Turtles were weighed, sexed, and measured for length and width of carapace, then released. For 2001, data for 250 turtles were analyzed. In 2002, a total of 118 turtles were trapped where 75 were new animals (37 males, 30 females, 8 juveniles) and 43 (34 males, 9 females) were recaptured turtles from 2001. Of the recaptures, 2 adult males moved between the 2 distant sloughs, 2 females were observed on land away from their respective sloughs (during breeding season), and 4 males (and 1 female) moved between the largest slough and the nearby tiny slough. In spite of intense trapping effort, trapping success between 2001 and 2002 varied greatly. Possible reasons for this difference, including mortality factors, will be investigated.

ANTIMICROBIAL ACTIVITY OF FLAVONOIDS ISOLATED FROM FOODS ON BACTERIA THAT CAUSE FOOD POISONING

Danielle Sexton
St. Mary's University of Minnesota, Winona, MN

Flavonoids are aromatic compounds commonly found in plant pigments. It has been suggested that they may exhibit antimicrobial activity. The main objective of this project was to compare the antimicrobial activity of three foods, apples, onions, and berries, known to have high concentrations of flavonoids. The flavonoids were isolated from the foods mentioned and were tested for their ability to inhibit the growth of four bacteria known to cause food poisoning. To test this objective, four bacteria, two that are gram-negative and two that are gram-positive, were used. The gram-negative bacteria were *Salmonella typhimurium* and *Escherichia coli*. The gram-positive

bacteria were *Staphylococcus aureus* and *Bacillus cereus*. To obtain the flavonoids, equal weights of the three foods were dried using a food dehydrator. Then each of the dried foods was added to a mixture of ethanol and HCl at 90°C for one hour. The resulting liquid was filtered and centrifuged under vacuum conditions to evaporate the liquid, leaving behind the isolated flavonoids. The flavonoids were re-suspended in tryptic soy broth (TSB). A Minimum Inhibitory Concentration (MIC) assay was completed to test the antimicrobial activity of the flavonoids. Of the three foods tested, the food showing the greatest inhibition ability is onion. The greater inhibition may be due to two possibilities. One possibility is that onions have more flavonoids, or that there are different flavonoids present in onions. Further tests need to be completed to say definitively which possibility is correct. The results will be analyzed, using an ANOVA test, to determine if one food is significantly more effective than another at inhibiting the growth of the bacteria. Additionally, the results will indicate whether one bacterial species is more susceptible than another to the flavonoids.

THE PRESENCE OF D-SERINE IN DIFFERENT DEVELOPMENTAL AND PHYSIOLOGICAL ENVIRONMENTS

Marysia Shudy
University of Minnesota, Twin Cities, MN

The objective of this project is to characterize the influence that the developmental and physiological states of the retina have on D-serine production in retinal glial cells. Evidence suggests that the NMDA type of glutamate receptor has a significant role in synaptic plasticity and transmission in some regions of the brain in adult and developing animals. It has been found that D-serine is manufactured by the glial cells of the retina and modulates NMDA-receptor-mediated responses in retinal neurons. Thus, further research on the role of D-serine and NMDA receptor function will increase the understanding of the type and amount of influence that glial cells have on the synaptic activity of the neural cells. Immunohistochemical techniques have been used to detect D-serine in the retinal layers of mice during 1) different stages of development and 2) during the light- and dark- phases of the mouse light cycles. It was hypothesized that 1) D-serine will first be detectable in the two retinal synaptic layers at the onset of their synaptogenesis and 2) that more D-serine is present in the light-phase than in the dark phase of the light cycle. The presence of D-serine has been successfully detected in adult mice retinal layers using a purified, anti-rabbit D-serine racemase. Current experiments are being conducted in order to continue the detection and analysis of D-serine in mouse retinal layers.

EXTRACTION OF PROTEIN FROM THE POLLEN OF COMMON RAGWEED, *AMBROSIA ARTEMISIFOLIA*: IMMUNOCHEMICAL QUANTIFICATION OF ANTIGEN AMB A I IN POLLEN OF PLANTS

Benjamin Singer, Lewis H. Ziska, and James G. Straka
Macalester College, St. Paul, MN

Common ragweed pollen (*Ambrosia artemisiifolia*) is a major aero-allergen. Methods for quantifying the antigenicity (allergenicity) of *Ambrosia* grown under varying levels of CO₂ are of biochemical and ecological interest. Previous methods for extraction of protein from pollen are time consuming, often requiring the use of strong organic solvents to remove waxes and surface lipids. We have developed a new method for extracting pollen protein: brief sonication of pollen suspended in buffer containing the mild non-ionic detergent Tween 20, followed by centrifugation. This method has been compared quantitatively and qualitatively with other commonly used methods. The described method requires about 30 minutes to process up to 20 pollen samples vs. 2-48 hours for the other methods. Total protein in the extract is highest using this method (24.2 µg/mg pollen vs. 6.6-7.8 µg/mg pollen). SDS-polyacrylamide gel electrophoresis demonstrated that the profile of proteins extracted by this method is similar to those obtained using the comparison methods. An enzyme-linked immunosorbent assay (ELISA) was used to determine antigen [Amb a] I content in protein extracted from pollen of *A. artemisiifolia* plants grown under controlled [CO₂]. Total pollen protein is not significantly different in plants grown at elevated (600 ppm), sub-ambient (280 ppm), and current ambient (370 ppm) [CO₂]. Pollen grown under elevated [CO₂] conditions contained over 1.9 times more Amb a I antigen than pollen from plants grown under sub-ambient conditions ($P < 0.005$), and about 1.7 times more than from plants grown at current ambient conditions ($P < 0.01$).

DNA FINGERPRINTING OF THE NERITE SNAIL COMPLEX OF SAN SALVADOR, BAHAMAS USING RANDOM AMPLIFIED POLYMORPHIC DNA (RAPD) ANALYSIS

Christina Sjogren
Cornell College, Mount Vernon, IA

Random amplified polymorphic DNA (RAPD) analysis will be used in an attempt to identify unique DNA fingerprints that might support the current taxonomic classification of four species of nerite snails found in San Salvador, Bahamas. The snails are morphologically distinct, although it is unclear when the four species diverged. I propose to search for diagnostic DNA fingerprints using RAPD analysis that may support current nerite taxonomic classification based upon morphology. This will allow future researchers to have more confidence when they classify

morphologically indistinct species using only DNA fingerprint analysis.

*Research occurring March 7-23

MECHANICAL CUTANEOUS HYPERALGESIA IN A RAT MODEL

Heidi Skoog, Don Simone
University of Minnesota, Twin Cities, Minneapolis, MN

Recent evidence suggests that cannabinoids may have analgesic effects that occur through peripheral mechanisms. Since skin blisters are painful, we investigated whether cannabinoids applied directly to a blister might decrease the pain. The aim of my research is two fold: 1) to develop a model to study hyperalgesia following a skin blister in the rat, and 2) to test the effects of various cannabinoid drugs in alleviating the hyperalgesia. Once animals are anesthetized with halothane, a suction blister is made on the plantar surface of the hindpaw using vacuum, (45-60 mm Hg) applied through a 3 mm diameter capsule. Shortly after formation of the blister, all animals exhibited mechanical hyperalgesia as measured by an increase in the percentage of paw withdrawals to controlled mechanical stimuli applied to the blister. The average percent of trials in which a withdrawal response occurred was 0-20% before the blister, and this increased to 70-100% after the blister. A cannabinoid drug, WIN 55,212-2 at a concentration of 20µg/µL, was applied directly to the blister did not alter the mechanical hyperalgesia. It is concluded that a suction blister in rats produces profound mechanical hyperalgesia, but that cannabinoids are not effective in alleviating this form of hyperalgesia.

AN APPLICATION OF THE FIRST LAW OF THERMODYNAMICS TO MAXIMUM TEMPERATURE FORECASTING

Sven Sundgaard
St. Cloud State University, St. Cloud, MN

Most often-maximum temperature forecasts are made in a qualitative rather than quantitative fashion. Rather than roughly estimate the effects of cloud cover and adjusting numerical model output, this research attempted to quantify the surface heat budget. This was done employing the First Law of Thermodynamics to the heating of the boundary layer of the atmosphere. The model was applied to real atmospheric data. The model forecast maximum temperatures were then compared to actual recorded maximum temperatures to study the validity of this model. A pilot study was also conducted accounting for variables, which induce much of the error. The results show that the model may be employed operationally under conditions where extremities of the atmospheric are absent.

CHARACTERIZATION OF MAIZE CHROMOSOMES IN OAT-MAIZE ADDITION LINES BY IN SITU HYBRIDIZATION

Ruth Swanson

St. Mary's University of Minnesota, Winona, MN

Radiation hybrids can be used for genetic mapping, physical mapping, cloning systems and studies of chromosome behavior. The objective of this project was to investigate the fate of maize chromosomes in a series of oat-maize addition lines provided by University of Minnesota researchers. Oat-maize addition lines are oat plants that include one or more maize chromosomes within the oat genome. Initially, fluorescence [in situ] hybridization (FISH) using a maize genomic probe was applied to interphase nuclei or root tips to confirm the presence of the maize chromosome(s) in the oat plants tested. Both monosomic and disomic maize chromosomes were observed in oat nuclei using this technique. Besides the presence or loss of the maize chromosome, a second objective was to characterize the experimental materials relative to whether the maize chromosome undergoes deletions, translocations with oat chromosomes, or other structural aberrations. In this regard, FISH needs to be applied to mitotic cells, not frequently observed in these root tips. Therefore, a protocol was developed that enhanced the frequency of metaphase figures in the meristem region of the root tip by three- to four fold. These results should be useful for the subsequent chromosome studies. Interest in the behavior of the maize chromosome in these lines lies within the many possible uses for radiation hybrids.

EFFECTS OF GREENSHELL MUSSEL FARMS ON THE DIVERSITY AND ABUNDANCE OF FISH IN OUTER PELORUS SOUND, SOUTH ISLAND NEW ZEALAND

Kristin Swenson

The world's supply of greenshell mussels relies solely on New Zealand's aquaculture industry. Mussel cultivation in New Zealand is relatively young and the effects on fish populations and the environment have not been extensively researched, yet are important to the sustainability of the industry. The purpose of this study was to provide further knowledge of fish populations in relation to mussel farms in outer Pelorus Sound, Marlborough Sounds South Island New Zealand. From 18 April 2002 to 9 May 2002 fish catches on long lines set inside and outside mussel farms were recorded and assessed according to size, abundance and diversity. The total number of fish caught in the two areas was not significantly different. However, more teleosts were caught inside mussel farms than outside, and more elasmobranchs were caught outside mussel farms than inside. The index of species compiled is beneficial to recreational and commercial fisheries that depend on Snapper (*Pagrus auratus*), a target teleost species, in addition to

scientists studying the general effects of mussel farms on the environment.

INHIBITION OF TUMOR CELLS BY CREATINE MONOHYDRATE

Anna Tomes

St. Mary's University of Minnesota, Winona, MN

Creatine is a naturally occurring molecule that plays an important role in the release of energy in the body. Creatine monohydrate is widely used by athletes as a dietary supplement because an increase in creatine leads to an increase in energy. Previous studies have shown that analogs of creatine inhibit tumor cell growth in vitro and in vivo. However, no study has determined whether naturally occurring creatine monohydrate, the form taken by athletes, also inhibits tumor cell growth. The purpose of this study was to determine if naturally occurring creatine monohydrate inhibited the growth of tumor derived from the immune system. DO11 lymphoma T cells were cultured with various concentrations (0, 10, 20, 33 mg/ml) of naturally occurring creatine monohydrate. Cell counts were taken on a daily basis for six days. Creatine inhibited cell growth, most noticeably at high concentrations of creatine. It is unclear, though, whether creatine causes cells to die or slows down the progression through the cell cycle. A Live/Dead Viability Cytotoxicity test will be used to determine if Cr is killing the cells. The DO11 cells will be cultured with and without creatine monohydrate and the percent live and dead cells will be determined after 48 and 72 hours using a fluorescent microscope.

THE PREFERENCE OF PRAIRIE RESTORATIONS USING SMALL MAMMALS AS AN INDICATOR.

Bretta Vrieze

Bethel College, St. Paul, MN

The abundance of small mammals in three different types of adjacent prairie restorations along the St. Croix River Valley was measured during the summer of 2002. The three types of restorations included native, warm season grasses (e.g. Indian, Big Bluestem, Switch); old, mostly non-native cool season grasses (e.g. Quack, Bluegrass, Brome); and diversely restored mixed plantings (50+ species of grasses and forbs). A total of ten transects, each containing ten Sherman traps placed every ten meters, were set in the three different field types. Data was collected three times a week during the months of June, July, and August. Species identification, trap location, mass and gender were recorded. Animals were then tagged and released. The distribution of animals caught from highest frequency to lowest frequency were meadow jumping mouse *Zapus hudsonius*, white-footed mouse *Peromyscus leucopus*, meadow vole *Microtus pennsylvanicus*, northern short-tailed shrew *Blarina*

brevicada, and the pygmy shrew "Sorex hoyi". Plant diversity and weekly plant heights for each site were also recorded. Results indicate that mammals do indeed show a preference to the diversely restored field plantings. Analyses of animal abundance as a function of plant diversity indicates a strong correlation; however, animal abundance is not dependent upon height. Therefore, there remains other variables such as field age, plant composition, plant structure and burn frequency that may influence animal preference. Future research may yield additional information indicating which restoration type provides greater ecosystem value.

**CONSERVATION OF THE TISSUE-SPECIFIC
EXPRESSION OF THE HUMAN NKX3.1 GENE IN RAT
PROSTATE AND KIDNEY CELLS**

Scott A. Youdas

Bethel College, St. Paul, MN

NKX3.1 is a homeobox gene expressed in a tissue-specific manner in human prostate cells. As a member of the homeobox gene family, it is most likely involved in prostate development, and there is some

evidence that mutations in the gene may lead to some forms of prostate cancer. This specific research project tries to answer the question: Will the human NKX3.1 gene promoter function in rat cells in a manner that is similar to that observed in human cells? Obtaining the answer should shed some light on how much conservation there is in transcription factors, gene regulation, and promoter sequences. To test this, rat prostate cells, rat kidney cells, and human prostate cells were maintained in culture and transfected with several plasmid constructs containing various length segments of the human NKX3.1 promoter that were ligated to the firefly luciferase reporter gene (coding region), and the activity of the promoter in the various cells was determined by assaying for luciferase. Statistical analysis of the data assists in determining how active each of the NKX3.1 promoter constructs is in the different cell lines used. The results of this analysis will be discussed.

NOTICE

A single issue of *The Journal of the Minnesota Academy of Science* will be published annually. This issue will continue to publish abstracts from the Academy's annual meeting. In addition, this same issue will contain professional papers accepted for publication in that cycle. Editorial policies remain unchanged; however, contributors are advised that manuscripts received after November 1 cannot be assured inclusion in the forthcoming spring issue.

DEDICATION

This issue of the *Journal* is dedicated to the memory of Dr. Ray Sicard. Ray was a long time member of the Academy and served in many capacities. Ray served several terms as member of the Board of Directors and as President of the Board from 1998 to 1999. At that time he moved from Minnesota to Kentucky. Even after his move to Kentucky, Ray continued to serve as *Journal* editor until his untimely death in October 2002.

Ray was a dedicated practitioner and teacher of science. His contributions to the Academy and science in general are beyond number. Those who knew him will surely miss him as a true colleague in science.