ABSTRACTS

BUSINESS AND ECONOMICS SYMPOSIUM

USING MEDIAN POLISH TO DEAL WITH CENSUS DATA SUPPRESSION
David P. Brennan and Laman L. Lundsten
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Retail sales data provided by the Census Bureau is increasingly incomplete because of the disclosure rule prohibiting release of data that would reveal the sales for individual establishments. Non-reported sales at the county level in Minnesota grew from 1.5% in 1948 to 28.8% in 1997. It is most problematic for sparsely populated counties like Clearwater, Cook, Mahnomen and Nicollet that had two-thirds of their sales categories non-disclosed. The problem is most acute for miscellaneous and general merchandise store categories that had over 65% of their sales suppressed. The disclosure problem is the result of a rapid decline in the number of stores and the rapid increase in general merchandise discount stores. Median polish generates a robust, additive model that estimates 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. Since the total retail sales for a county is available, this can be used to improve the estimates further. The technique is generally applicable for all states and could be extended to deal with data suppression in other census data.

A PRACTICAL APPLICATION OF GMMSO©
Stacy Gibson
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The purpose of our research project was to assist an selected company design an international marketing/business plan for an identified market using the Global Marketing Management System Online (GMMSO©). GMMSO© is a strategic management tool designed to help companies enter or expand their presence in foreign markets. The system includes four phases:

Phase 1: Company situation analysis - The situation analysis determines the company's current position vis-a-vis international markets. Based on analysis and evaluation, a report is prepared to the company outlining key findings and recommendations.

Phase 2: Global market search: determining global market opportunities - The purpose of global market search is to design and execute a plan to identify market countries with the greatest potential for the company's products or services.

Phase 3: In-depth market analysis of selected countries - The purpose of this is to identify the best country market with the greatest potential for the company's products/services.

Phase 4: Entry strategy and the global marketing management plan - Based on the findings from phases 1-3, an entry strategy and marketing program is developed in conjunction with the firm's top management. From entry strategy on, the plan should be designed to minimize the risks and maximize profits while entering/expanding the company's presence in global markets.

In conclusion, the GMMSO© program is a practical, education program that can help professors, students, or businesses seeking to work with international business.

TOBACCO STOCKS: THEY JUST KEEP ON SMOKIN'
Richard Goelke
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Given lawsuits, anti-smoking legislation, and a decline in U.S. demand for tobacco products, why do tobacco stocks continue to perform so well? The presentation addresses this issue by looking at three factors: 1) tobacco stocks have desirable correlations to the S&P 500 Index, 2) tobacco companies offer superior earnings per share growth rates at inexpensive price-earnings ratios, and 3) lawsuit settlement charges have been significant but not devastating to earnings. The result is that tobacco stocks continue to have high levels of institutional ownership, specifically mutual funds and pension funds, even with the trend toward socially responsible investing.

GLOBAL ACTORS THINK LOCAL: RESPONSIBLE CORPORATE ACTION IN A WORLD ECONOMY
John Hasselberg
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My thesis is that the objective of alleviating local economic, political, and social injustices is consistent with corporate international investment and market expansion strategies. This approach to corporate social responsibility envisions a move away from "do no harm" approaches that just react to ethical problems, perceived problems, or accusations of unethical behavior. Since most multinational organizations are emissaries from and representatives of democratic capitalist nations, I argue that they have a duty to actively and consciously create sustainable and humane growth strategies in transitional societies. My proposition is based upon the assumption that a "War on Terrorism" cannot be won as long as extremely unjust economic, political, and social structures prevail in much of the world. I contend that it is incumbent on globally active corporations to consciously assess and include in their strategic planning heuristics on how their investments and market plans will help to resolve these threats to economic security and, thus, to the sustainability of international business. Successful business people know that for them to continue to be successful their products and services must make a positive difference in people's lives. Business people have unique managerial skills and organizational...
Abstracts

experiences to apply to addressing some of these inequities. This project defines an approach to sustaining and enhancing democratic capitalist systems from which all private businesses so richly benefit and without which they would not exist.

THE GLOBAL MARKETING MANAGEMENT SYSTEM ONLINE (GMMSO©)
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Globalization and information technology (GIT) are two of the most dynamic forces that will be determining the ability of private sector companies and public institutions to compete and grow in the global economy of the 21st century. The Global Marketing Management System Online (GMMSO© http://www.gmmso.com) consists of a process designed to assist students and managers alike in researching global business opportunities and developing international business/marketing plans. The GMMSO© is a sound pedagogical tool with several advantages, such as being friendly, interactive and integrative, cognitive and experiential, resourceful and innovative, and multidimensional. The GMMSO© can assist several diverse groups, including business faculty and students and those in related fields of study; non-exporting companies interested in identifying global market opportunities; international companies contemplating global expansion; trade specialists and consultants; or anyone interested in the globalization process. The GMMSO© provides tools needed to expedite the planning process in a timely, cost-effective and efficient manner. Moreover, the GMMSO© should contribute to information technology initiatives undertaken by Colleges of Business by providing faculty and students a learning tool they can use to integrate technology into business courses.

SELF-SERVING ATTRIBUTIONS AS A FACTOR INFLUENCING A SUPERIOR’S VOLUNTARY DISCLOSURE FOR AN UNFAVORABLE OPERATIONS VARIANCE INCURRED BY A SUBORDINATE
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The proposed study seeks to analyze whether self-serving attribution motives by superiors affect their likelihood to voluntarily disclose facts indicating a subordinate in explaining causality for an unfavorable operations variance incurred by the subordinate's operations unit. We conceptualize a superior's initial attributions for an operations variance as either internal or external. Internal attributions mean that the superior believes that the subordinate is personally responsible for the variance, whereas external attributions imply that the superior believes that environmental factors beyond the subordinate's control were the cause of the unfavorable operations variance. Following the superior's initial attribution process, he/she would next decide how to report or disclose the operations variance to higher management within the firm. It is hypothesized that superiors who initially attribute the variance to the subordinate will voluntarily disclose the variance to the subordinate will voluntarily disclose indictment or damaging information about the subordinate. Conversely, if a superior's initial attributions are external for the unfavorable operations variance, the superior would voluntarily disclose more situational and less personal explanations for the variance's occurrence. The proposed study will be presented in conceptual, model form with hypotheses given as propositions.

DOING BUSINESS IN THE CZECH REPUBLIC: AN OLD CULTURE AND A NEW SCIENCE
Stuart M. Stoller
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Today the science of finance is driven by equations and ratios. A “business valuation” can be calculated by using an equation for discounting future cash flows or ratios to determine liquidity, leverage and profitability. The science of finance uses mathematical tools. The norms of these mathematical models only work for western free market cultures. These models are not universal. The countries of the former Soviet Union, even though free market cultures, have a need for a new set of tools. The development of the “western markets” started during the Industrial Revolution and evolved into today’s “free market system.” This history and culture is very different from the conversion of former Soviet Union countries into free markets. My research is now directed towards developing these new mathematical models. Can state-owned property be privatized use a discounted cash flow method for valuation? Perhaps certain cultures should be discounted for a particular history and a premium added for others. Of course, there is a degree of subjectivity to this economic hand-capping. Even in the traditional western models, the science of finance is based on subjective information. For example, how many years of cash flows should be included in the cash flow formula? This new finance will be a combination of culture and mathematical modeling. Development of new mathematical applications is not required as much as is applying them in more flexible and diverse ways.

ECOLOGY SYMPOSIUM

CAN THE AMERICAN KESTREL (FALCO SPARVARIUS) USE UV LIGHT TO DETECT THE URINE TRAILS OF PREY?
Catherine Angle
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This study focuses on whether the American kestrel (Falco sparvius) can detect the urine trails of rodents using ultraviolet (UV) light. Recent studies have shown that passerines (song birds) use UV vision for various tasks/decisions including mate choice and detecting berry ripeness; however, raptor species have been almost ignored. Only two rapids have been studied, both European. One was found to use UV vision to help
detect the presence of small mammalian prey and one was not. My study uses the same principles used to test European species to test an American raptor. By offering different visual stimuli as choices to fasted birds, I was able to determine if they showed any preferences for the stimuli that reflected in the UV range. The study found that those birds which were not strongly imprinted showed a preference for UV-reflecting stimuli; however, the small sample size limits projection of ecological applications.

**Changing Perspectives in Restoration Ecology**

Mark Davis  
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The field of restoration ecology is in danger of losing its scientific credibility and public support if it continues to be dominated by several traditional restoration goals and assumptions. For example, conceptual frameworks commonly used to guide and justify many restoration efforts are “ecosystem health” and “ecological balance”. Yet neither concept is supported by current ecological theory or findings. Similarly, the dichotomous categorization of species as “native” or “exotic” lacks a strong ecological justification. A belief in, and passion for, “native environments” has often led restoration ecologists to try to recreate environments of the past. However, dramatic changes in disturbance regimes and regional species assemblages, and predicted changes in climate, make it highly unlikely that such efforts can succeed. A perspective that categorically sanctifies native environments and vilifies newly arrived species represents a kind of historical nostalgia that has prevented a more pragmatic and ecologically sound approach from taking hold in restoration ecology. Such an approach would abandon, as guiding principles, arbitrary and value-laden notions such as “native environments” and “exotic species”. Instead of classifying species on region of origin, this approach would identify desirable and problem species based on the ecology of the species and the goals of the particular restoration project. In this case, species deemed desirable or problematic could include both ones long established in the region and ones newly arrived. In sum, if the field of restoration ecology is to mature as a scientific discipline and to become a more flexible and responsive approach. In doing so, the field needs to be open to changes in philosophy, language, goals and objectives, and to gain its direction more from looking to the future than trying to recreate the past.

**Progress of a Bluff Prairie and Oak Savanna Restoration – 5 Years Down the Road.**

Sarah Cronlund Fuller  
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A five-year vegetation-monitoring project at The Nature Conservancy’s Ottawa Bluffs in Le Sueur County, Minnesota shows species level changes in prairie and oak savanna understory vegetation during restoration activities. The percent cover of each species in 29, permanently marked, 1m² plots was determined each year between 1997 and 2001. Restoration activities were ongoing throughout the study period and included removal of *Juniperus virginiana* and *Rhamnus cathartica*, burning of cut trees, planting of native seeds and seedlings on burn pile scars, and prescribed fire. *Rhus typhina, Melilotus spp.*, and *Poa pratensis* increased between 1998 and 2001. *Parthenocissus quinquefolia, Cirtium arvense & C. vulgare, Eupatorium rugosum, and Schizachyrium scoparium* decreased between 1998 and 2001. Species that did not change between 1998 and 2001 are *Rubus flagellaris complex, Vitis riparia, Rhamnus cathartica, Andropogon gerardii, and Sorghastrum nutans*. These data also show that the total percent cover by native species in oak savanna or prairie-opening plots did not change over the study period. However, the percent cover by natives was consistently lower in the oak savanna than in the restored prairie opening. Percent cover by natives in plots on burn pile scars increased, probably as a result of direct seeding of native species at those sites.

**Contrasting Responses of Plant Communities to Nutrient Addition on Landscapes with Different Glacial Histories in the Alaskan Arctic.**

Sarah E. Hobbie  
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Previous work in Alaskan tundra has shown that the dwarf birch, *Betula nana*, dominates the response of tundra to nutrient enrichment. *Betula’s high capacity to accrue biomass in response to fertilization suggests that tundra will become “shrubbier”, with greater carbon storage, as climate warms and soil nutrient availability. However, while *Betula* is common on older landscapes with acidic soils, it is quite rare in non-acidic tundra on younger glacial landscapes that make up a large proportion of the Alaskan Arctic. We compared the response of plant cover, biomass, and production to annual nutrient (nitrogen + phosphorus, N+P) addition over four years between moist tussock tundra dominated by *Betula* and moist non-acidic tundra where *Betula* is rare. Addition of N+P increased relative percent cover of deciduous shrubs at the older, acidic site, but increased graminoid and forb cover at the younger, non-acidic site. Total vascular biomass and production increased, while non-vascular biomass decreased, with fertilization at both sites. However, increased production at the acidic site resulted from a tripling of the production of the dwarf birch, *Betula nana*, while increased production at the non-acidic site resulted from small increases in the production of species in a number of growth forms. Thus, differences in plant community composition between the sites yielded strikingly different trajectories of response to fertilization. Increased nutrients at the non-acidic site, where graminoids are common but shrubs (particularly...
Betula nana) are rare, led to greater production of herbaceous species and leaf biomass that has a short turnover time and a low capacity to store carbon. At the acidic site, Betula nana dominated the response to fertilization, resulting in greater stem production with a long turnover time and a high capacity to store carbon. These results suggest that glacial history, by influencing soil characteristics such as pH that affect the relative abundance of sedges versus woody shrubs, will strongly influence how increased nutrient availability associated with climate warming will change future tundra carbon balance.

ELEVATED CO₂ EFFECTS ON GRASSLAND ECOYSYSTEM PROCESSES
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Atmospheric CO₂ concentrations have been steadily increasing over the last several decades. The direct and indirect effects of elevated atmospheric CO₂ on ecosystem processes, such as primary production and decomposition, may have important consequences on the rates of biogeochemical cycling of carbon and nitrogen and the long-term sustainability of ecosystems. We began a study in 1997 to examine the effects of elevated atmospheric CO₂ on shortgrass steppe ecosystems. Six open-top chambers were established at the Central Plains Experimental Range in northeastern Colorado. Ambient air (~365 ppm CO₂) was circulated through three of the chambers, and ambient air enriched with CO₂ to ~720 ppm CO₂ was circulated through the remaining three chambers. Three additional nonchambered plots were established to monitor the effects of the chambers. In the first three years of the study, plant growth under elevated CO₂ increased biomass production by approximately 35% compared to biomass production under ambient CO₂. This increase in plant productivity was accompanied by decreases in plant nitrogen content. Aboveground plant nitrogen concentrations during the peak of the growing season were 21% lower in elevated CO₂ plots compared to ambient CO₂ plots. Such decreases in plant tissue quality are expected to lower decomposition rates. Our laboratory measurements indicated little effect of growth under elevated CO₂ on rates of aboveground plant tissue decomposition but important effects on belowground biomass decomposition. Root decomposition rates were significantly higher for roots grown under elevated versus ambient CO₂. In an ecosystem in which roots comprise a majority of the total plant biomass, differences in root decomposition following exposure to elevated CO₂ will have important impacts on whole ecosystem responses to elevated CO₂.

MECHANISMS OF PLANT SPECIES IMPACTS ON ECOSYSTEM NITROGEN CYCLING.
Jean Knopps
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Plant species are hypothesized to have positive feedbacks on ecosystem nitrogen cycling because of differences in nitrogen use efficiency. In a 2-yr decomposition study of 5 grass species at the Cedar Creek LTER, the majority of nitrogen present within litter was not released, a common observation in litter decomposition studies. A long time lag between litter formation and nitrogen release may weaken any feedbacks between plant tissue quality and nitrogen cycling. The 5 species differed 3-fold in nitrogen use efficiency, but patterns of productivity did not support the view that differences in plant nitrogen use lead to positive feedbacks with either nitrogen cycling or NPP. However, the study did find 25-fold differences in belowground productivity and large differences in net nitrogen mineralization. These data support the hypothesis that belowground plant carbon inputs drive microbial immobilization of nitrogen, thus controlling patterns of net nitrogen mineralization. Differences in plant carbon inputs caused by plant productivity lead to a negative feedback through microbial immobilization. Thus, our evidence does not support the view that plant species have positive feedbacks through nitrogen use efficiency on nitrogen cycling. In contrast, there is abundant evidence that plant species impact nitrogen inputs and losses, such as: atmospheric deposition, fire induced losses, nitrogen leaching, and nitrogen fixation, which is driven by carbon supply from plants to nitrogen fixers. Additionally, plants can influence the activity and composition of soil microbial communities, which have the potential to lead to differences in nitrification, denitrification, and trace nitrogen gas losses. Plant species also impact herbivore behavior and, thereby, have the potential to lead to animal-facilitated movement of nitrogen between ecosystems. Thus, current evidence supports the view that plant species can have large impacts on ecosystem nitrogen cycling, but these affects are not the direct consequence of species differences in nitrogen use efficiency.

ECOLOGICAL ASPECTS OF LEAFY SPURGE (EUPHORBIA ESULA) INVASION AND CONTROL IN A NATIONAL PARK
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The global spread of nonindigenous organisms is predicted to result in homogenization of the Earth's biota. While this is undoubtedly true on large scales, can the same be said at the scale of individual plant communities? Research on Euphorbia esula-infested mixed-grass prairies at Theodore Roosevelt National Park is beginning to shed light on how plant communities differ in the presence of an invader and on processes that may influence plant community composition. I will focus on two aspects of this
research. First, are plant communities that harbor a large infestation of *E. esula* more similar to each other than plant communities lacking the infestation? A canonical discriminant analysis of five community types revealed substantial differences between infested and non-infested plots within a given plant community as well as similarities among infested communities from different plant species that specialize on clonal organs, pathos, and non-clonal plants. We monitored 140 clones of Missouri goldenrod, *Solidago missouriensis*, for 10-15 years, including some clones apparently killed by a defoliating, cutworm beetle, *Trirhabda canadensis* that specializes on clonal goldenrods. Some of the “dead” clones reappeared 1 to > 13 years after defoliation, vigorously “reclaiming” entire or large segments of their original territories (80 - 500 m²) in a single year. We tested three hypotheses explaining this phenomenon. Data support the hypothesis that defoliated clones become dormant for extended periods.

**THE RESPONSE OF ADULT *XENOPUS LAEVIS* TO A PROPOSED CONSPECIFIC DISTURBANCE SIGNAL**

*Amanda Newsom*

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Many aquatic animals exhibit antipredator responses to chemicals released by conspecifics upon detection of potential predators. Chemicals that elicit antipredator response may be substances from damaged tissues or may be released early in a predation sequence before prey individuals suffer damage. This later type of chemical warning is a disturbance signal and has been widely studied in fish and in a few species of larval amphibians. Little is known about whether adult amphibians use disturbance signals. In this study, I compared the responses of adult African clawed frogs (*Xenopus laevis*) to water from a stimulus tank containing either 1) conspecifics disturbed by a simulated predator response, 2) conspecifics left undisturbed, or 3) a simulated predator attack in water without conspecifics. Two tanks were used, one containing two conspecific sender(s) and/or simulated predator attack and the other containing a single test individual. Water was kept flowing continuously between the two tanks. Test frogs exhibited a non-significant tendency towards increased activity per ten minute observation period when exposed to water that contained disturbed conspecifics (N = 25). It appeared that test frog responses included a sudden, initial increase in motion followed by a period of depressed activity. In future, motion should be quantified at intervals of 2.5, 5, and 10 minutes.

**BLUE SKIES AND GREEN LAKES: RECONSTRUCTING THE IMPACTS OF LAND-USE CHANGES ON LAKE PRODUCTIVITY.**

Charles Unbanhowar

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Eutrophication of lakes and the management of phosphorus (P) inputs continues to be of broad interest to research ecologists and resource managers with management targets for lake nutrient inputs often based on regional comparisons of lake waters. In this study, pre-Euroamerican (1650-1850) P-inputs to Lake Volney (Le Sueur County) were reconstructed using sediments from multiple cores and compared to inferred changes in lake productivity and changes in land-use post-Euroamerican settlement abstracted from census and tax records. P inputs to the lake ranged from 305 - 385 mg/m²/yr prior to the arrival of Euroamerican agriculture in the 1850s when P inputs increased nearly three-fold, largely as a result of increases in organic and non-apatite inorganic P. P inputs were highest in 1928 (3895 mg/m²/yr) when organic, apatite and non-apatite P all increased again. Modern P inputs are 1529 mg/m²/yr. Inferred lake productivity showed little change until the 1910s after which they increased to 5-10 times greater than the period from 1650-1900. The initial increase in P inputs observed in the 1850s corresponded directly to the arrival of Euroamericans in the Lake Volney watershed. Causes for the second increase in P inputs seems to be related to an overall increase in large animal numbers (swine and cattle) that began in the 1910s. The methods combined in this study can quickly and inexpensively provide site-specific reconstructions of lake history that can provide a baseline for lake management and restoration.
Venetian History: A Multiple Scales Analysis
Mark Branda
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Against the backdrop of barbarian invasions, the collapse of the Roman Empire and the foundation of the Byzantine Empire in the East, Venice was born. Venice’s peripheral location at the north end of the Adriatic allowed the fledgling city to withdraw itself from conflicts that preoccupied neighboring mainland cities. This isolation proved to be one of Venice’s greatest assets, allowing the city to carefully sculpt its future. Venice’s marginal position in the lagoon, its delicate perch between the competing political powers of the Lombards in Italy and the Byzantine Empire in the east, between rival church hierarchies, and between two cultural influences, Latin and Greek, led to a unique urban history. However, this isolation was not based exclusively on Venice’s relative location within the lagoon, but also its remoteness from the major cities of the Early Middle Ages, including Rome, Constantinople, Antioch, and Alexandria. This unique spatial isolation formed the foundation for the relationships between Venice and its immediate neighbors, its trade partners at the intermediate scale, Venice’s subsequent empire, and, at the largest scale, the Mediterranean basin and mainland Europe. An analysis of Venetian history at these multiple scales illustrates Venice’s unique locational position in the context of trade, urban design and architecture, and its stable and enduring political autonomy.

Community GIS: Addressing Issues with Maps
Christina Danica, Laura Jones, Sele Nadel-Hayes, and Tim Wallace
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Many neighborhoods and community groups have begun to use geographic information systems (GIS) in a wide range of tasks related to planning and management in urban areas. One possible mode of provision of GIS to such groups is through university-community partnerships. Macalester College’s Urban GIS class has partnered with the college’s community development fund, as well as three different neighborhoods adjacent to campus, to study the issue of off-campus Macalester student residences in the neighborhoods and relationships between the campus and the broader community. We will present the results of our GIS analysis of off-campus student housing issues and neighborhood dynamics. We will also discuss issues encountered with data acquisition, validity, use, and presentation. Finally, we will comment on the advantages and disadvantages of this mode of GIS provision to community organizations.

The Effect of Regional Paradigms on Transportation and Land Use Planning in Cascadia
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The coastal Pacific Northwest, also known as Cascadia, is a region known for its environmental consciousness and commitment to quality of life issues. I first give attention to what extent these themes influence the transportation and land use planning of a particular city in the region by conducting primary qualitative interviews with those involved in the planning process. The information gathered is used to analyze the recent and current planning initiatives within the city. Then, incorporating secondary research measuring the effectiveness of transportation and land use planning strategies according to other relevant paradigms (e.g., economic), I will critique current planning efforts and suggest appropriate initiatives for the future.

The Economic Impact of Noise Pollution: Trends in the Property Value of Homes within the Minneapolis/St. Paul International Airport Noise Contour
Daniel Hubbard
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Noise pollution is perhaps the most significant negative externality associated with airports. That noise pollution has a negative effect on quality of life is indisputable. However, the dollar value placed on this externality is highly debatable and the focus of much political process associated with the construction and expansion of airports. Although no comprehensive system of pricing externalities has yet been devised, one place to start is to compare the property values of those homes affected by airplane noise to those that are not. Using quantitative methods and census tract data, I examine trends in property value for homes within the “noise contour” of the Minneapolis/St. Paul (MSP) International Airport. These trends are then compared to metro-wide trends in home value over the same time period in an attempt to determine the impact of airplane noise on residential property values within the MSP noise contour.

Historic Beer Breweries in the Minnesota River Valley
Isaac Johnson
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There were approximately 37 beer breweries in the Minnesota River Valley circa 1900. The purpose of this study is to map the locations of these historic breweries via historic brewery directories and photographs and offer possible explanations for their strong market-orientation. The presence of springs and caves was thought to be a factor in the location of breweries. Springs were a constant source of fresh water while caves provided the means to store the beer. A number of old brewery sites were inspected to check the presence of these natural features. Beer brewing also
has been closely associated with German culture areas. Was this the case in the Minnesota River Valley? Are concentrations of German settlement areas correlated with concentrations of beer breweries? Finally, what factors led to the demise of many of these breweries during the 1900s?

**The Brewing of a Small Business: Caribou Coffee Locations in the Twin Cities Metro Area**

Beth Kasid  
*Dept of Geography, Gustavus Adolphus College, St. Peter, MN*

A brief history of the founding of Caribou Coffee is first presented. Data is then collected on the number and location of Caribou Coffee shops from 1992-2001 in the Metro Area. It was found that the diffusion of Caribou Coffee shops follows a typical S-shaped curve. Next, the stores were plotted on a map to show their spatial diffusion. The following locational hypothesis was tested: is there a correlation between high-income areas and the location of Caribou Coffee shops? Several overlay mapping methods seemed to confirm this correlation. Finally, a spatial comparison is made between the location of Caribou and Starbucks coffee shops in the Metro Area.

**Historic and Modern Rates of Sediment Delivery to the Upper Mississippi River**

David W. Kelley  
*Dept of Geography, University of St. Thomas, St. Paul, MN*

An assessment of the modern and historic fluxes of sediments exiting the Mississippi, St. Croix, and Minnesota watersheds was conducted. A provenance technique and elemental signatures for the rivers and sediments in Lake Pepin, a riverine lake on the Upper Mississippi River, were used to apportion sediments to their watersheds. Sediment fluxes and erosion rates were calculated for each basin. Whole-sediment loading to the lake shows a 12-fold increase from historic levels in the mass of Mississippi River-derived sediments. This river supplies more than 7 times the amount supplied by the headwater-Mississippi and St. Croix Rivers combined. Sediment contributions from these two combined watersheds have risen 7-fold since settlement of the region circa 1830 AD. The causes of these increases are attributable to intensive agricultural production, a decrease in wetlands and prairie, and an increase in acreage artificially drained within the Minnesota River basin.

**Sudanese Immigration and Resettlement in Southern Minnesota**

Amanda Peterson  
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As a result of war, civil strife, and malnutrition in Sudan, thousands of Sudanese have been forced to become both internal and external refugees. Fearing persecution, many Sudanese refugees have sought asylum in Minnesota, a land and people vastly different than their arid, desert homeland. This study examines the instigating causes of external migration, including the “push” and “pull” factors influencing their relocation to the United States, specifically the state of Minnesota. Analysis of Sudanese migration and resettlement patterns across southern Minnesota allows the following geographical question to be examined: Why are Sudanese communities located where they are? Quantitative and qualitative data provide further information pertinent to the topic of Sudanese immigration and resettlement in southern Minnesota.

**Distinctive Legal Features of American Indian Reservations in Minnesota**

Frank Shockey  
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Within the external boundaries of Minnesota are areas over which the federal and state governments do not have complete authority. These areas generally are called “Indian Reservations” in spite of variations among their statuses and among the processes by which they have evolved. Factors such as land ownership patterns on or near reservations, the histories of reservations’ evolutions, and also the specific language of treaties, contribute to the decision of what government presently commands authority over which activities in these areas. This presentation examines a few of the most distinctive examples of reservations in Minnesota, showing how the details of changing policy initiatives, as well as climatic court cases, have shaped Minnesota’s legal “landscape.”

**A Geography of Electricity in Minnesota**

Rod Squires  
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Electricity has transformed society and landscapes in the United States. Its impact is far more pervasive than the impact of the automobile. Produced in a variety of ways, transported considerable distances, and consumed in ever-increasing amounts, it sustains both rural and urban communities. The presentation will outline the current structure of the electrical industry in Minnesota.

**Assessing the Quality of a Transit System in a Metropolitan Area**

Annie Taff  
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There are many variables when considering the quality of a transit system: reliability, comfort, economic efficiency, speed, profitability, effectiveness as an alternate mode of transportation, and popularity. Underlying these characteristics of quality transit are the concepts of time, convenience, and accessibility. In an effort to rate the quality of a bus system within specific areas of a metro region, I plan to create a quantitative method that will rank sections of the system based on time, convenience and accessibility. After constructing a rating scale of quality based on these variables, I will apply my method to the Twin Cities. By applying the method to subdivisions of the Twin Cities, I will be able to determine the quality of the bus system within these specific areas. Finally, using data on income levels, employment numbers and prevalent land use, I will
Abstracts

determine which types of urban areas within the Twin Cities are receiving the highest quality bus service and which areas are receiving the lowest quality service. This information should lead to projections on improving the bus system in the Twin Cities.

The utilization of wind power by Minnesota rural electric cooperatives.
Jeff Young
Dept of Geography, University of Minnesota

Forty-five rural electric cooperatives distribute power to their consumer-members over a wide area of Minnesota. Most of the cooperatives were established during the Great Depression with the assistance of low interest loans from the Rural Electrification Administration. Initially, the cooperatives purchased wholesale electricity from investor owned utilities and the federal government. Later on, the cooperatives established generation and transmission cooperatives (G&Ts) to augment their power supplies. Most of the electricity distributed by cooperatives today is generated from out-of-state coal resources. Wind-generated electricity provides an opportunity for G&Ts to supply distribution cooperatives with "home grown" power that stimulates economic development in the areas that they serve.

Winchell Undergraduate Research Symposium

Differential ERK activation in Chinese hamster lung (CCL39) fibroblasts by primary alcohols and dominant-negative MEK.
JaDean J. Anderson, Brad A. Moran, Mark A. Wallert and Joseph J. Provost
Dept of Biology and Chemistry, Minnesota State University Moorhead, 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 α₁-adrenergic agonist phenylephrine (PE) activates NHE through an ERK-dependent pathway. We believe that PE stimulation diverges and involves several intermediates in the regulation of NHE. One pathway involves the activation of phospholipase Cβ, protein kinase (PK) Ca, Raf-1, MEK and Erk. A second potential pathway, involves the PKC-mediated activation of phospholipase D (PLD). PLD converts phosphatidocholine to choline and phosphatidic acid. In some cells 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 determine the involvement of PLD in this activation process and whether the activation occurs at the level of MEK or above. The involvement of PLD will be tested by the addition of the primary alcohols butanol and ethanol to the cells. If PLD is involved, this will block formation of phosphatidic acid and the activation of the Ras-Erk pathway. By adding a secondary alcohol to the cells, PLD will not convert phosphatidocholine to phosphatidic acid, thus having no effect on ERK regulation. To investigate the activation of the Ras-Erk pathway at the level of MEK, a dominant-negative MEK construct has been transfected into cells. This construct blocks passage of the signal from Raf-1 to Erk. Erk activation by PE is completely blocked by the addition of dominant-negative MEK.

Gene therapy and sickle cell anemia: testing the specificity and efficiency ex vivo of generated targeted delivery systems.
Leah Arnold
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Gene therapy may eventually provide effective treatments for a plethora of diseases, inherited as well as non-inherited, that are at presently incurable. This is the key to finding a cure for sickle cell anemia. At present, treatment for sickle cell anemia involves medications that treat the health complications that this disease causes. However, even with this treatment, people often do not survive past their fourth decade of life. This research was aimed at correcting the single base mutation found in sickle cell anemia via a gene therapy approach based on gene repair utilizing a RNA/DNA oligonucleotide that is targeted to the precise genomic sequence. The chimeraplast was compacted with polyethyleneimine, which is a cationic polymer that possesses intrinsic endosomalytic ability. I therefore tested ex vivo the specificity and efficiency of generated targeted delivery systems in order to determine the success of correcting the single base pair mutation that causes sickle cell anemia.

Cancer's effect on nociception in the mouse: a new rodent model of bone cancer pain.
Christopher J. Bjorn
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The Clohisy group in the Department of Orthopedic Surgery and Cancer Center at the University of Minnesota has developed a model of bone cancer pain in the mouse. This model has been used in the study of interactions between tumor and peripheral nerve and in investigations concerning nociception in the peripheral nervous system. I have conducted an investigation into the effects that bone cancer may have on pain pathway neurons in the mouse central nervous system. Through isolation of single neurons in the spinal cord and monitoring their electrical activity both at rest and following stimulation, I have been able to show preliminary evidence of changes in nociceptive activity of CNS neurons resulting from the presence of cancerous tumors. Electrophysiological study was conducted on mice that were shown to be hyperalgesic, due to cancerous tumors, in behavioral studies. We have found that a greater proportion of nociceptive cells in cancer animals have spontaneous activity and their response threshold to mechanical stimulus is decreased. We also have found that the heat
threshold has decreased and WDR nociceptors appear
to be desensitized to cold stimulus. Further
investigations into spontaneous activity, mechanical
stimulation, response to heat and cold, and exposure to
ET-1 are currently being conducted. (Performed in the
laboratory of Dr. Donald Simon, Univ Minnesota
Neuroscience Grad Program; funded by the Hamline
Univ Lund Fund)

Phenytoine-induced activation of the Na⁺-H⁺
exchanger in Chinese hamster lung (CCL39)
cells requires the activation of PKCa
Heidi A. Boyum, Nicole L. Korpi, Melanie R. Punfar, Joseph J.
Provost, and Mark A. Wallert
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Moorhead, Moorhead, Minnesota

The Na⁺-H⁺ exchanger isoform 1 (NHE-1), which is
present in virtually all mammalian cells, has been linked
to a variety of hormones, growth factors, and
oncogenes. The mechanism of the activation of the
NHE-1 varies depending on cell and agonist type.
Phenytoine (PE) activation of NHE-1 requires extracellular kinase (ERK) activity. ERK-mediated NHE-1
activation can occur through a Ras-dependent or
independent pathway. The involvement of pyruvate
kinase (PK) Ca in PE-induced α₁-adrenergic activation
ultimately activates ERK and NHE-1 by phosphorylation
of upstream elements of the ERK signaling pathway. The
role of PKCa in both ERK and NHE-1 activation was
studied. Addition of PE increased both phosphoryla-
tion of ERK and activation of NHE-1. Pre-incubation
with a nonspecific PK inhibitor, staurosporine, blocked
PE-induced ERK and NHE-1 stimulation; thus, showing
the dependence on ERK activation. Pre-incubation with
Go G976 blocked PE-induced ERK and NHE-1
activation; thus, indicating that PKCa was specifically
involved in the PE signaling pathway. Addition of PE
leads to translocation of PKCa. In the inactivated
state, PK is soluble (cytosolic) or loosely associated
with the plasma membrane. Upon activation, PKC
becomes tightly associated with the cell membrane,
intracellular localization of PKC after addition of PE was
determined by analyzing fractions of the cytoplasm
and the membrane by western blotting. In addition,
fluorescence microscopy with GFP/PKC fusion protein
was used to follow the movement of PKCa through the
cell before, during, and after PE addition. The data
suggests that PKCa translocation was involved in ERK-
maintained activation of NHE-1 by the α₁-adrenergic
receptor and phosphorylation of Raf. (Supported by
grant MCB-0080243 from the NSF.

Effect of alarm cues on visual cues in glow light
tetras
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Fishes of the superorder Ostariophysi have
epidermal cells that contain chemical alarm cues. These
chemical cues, commonly called alarm substances, alert
the fish to the presence of a possible predation threat.
Fishes do not rely on chemical information alone. The
visual presence of a predator also indicates predation
risk. Here, I explore the interaction between chemical
alarm cues and visual presence of a predator. Two
glowlight tetras (Ostariophysi, Characidae: Hemigramas
erthrozona) were placed in 37 L tanks. A second 37-L
tank, adjacent to the first one but separated by an
opaque barrier, contained a convict cichlid (Archocentrus
nigrofasciatus) or nothing (control). Each
tank consisted of three equal periods: 1) the pre-stimulus
period, 2) injection of the chemical stimulus period, and
3) the visual stimulus period. I observed: 1) activity, 2)
vertical distribution, and 3) proximity to the predator.
Tetras decreased activity, and increased time near the
bottom in response to alarm substance. When the
barrier was removed, tetras conditioned with alarm
substance showed greater intensity of avoidance
behavior of the predator than tetras conditioned with
water, indicating that the antipredator response to visual
stimuli is primed by chemical information.

The design and implementation of a Python-based
parallel processing library
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In the field of cluster computing, a collection of
networked workstations functions as a single logical
parallel processor. In this environment, software
development is usually done using special "parallel
processing libraries" that build upon and extend a
particular host language. These libraries contain routines
for parallel operations such as message passing,
broadcasting, and synchronization. The parallel
processing library MPI, which extends both C/C++ and
FORTRAN, is by far the best known and widely used.
For my research project, I designed and implemented a
parallel processing library. However, I chose to start
with the host language called Python. This is a new
programming language created to improve programmer
productivity and reduce software development costs.
My library, called PyMPI (Python, MPI-Style), provides
a set of parallel operations similar to MPI. However,
by basing my work on Python, I hope to be able to reduce
both the cost and complexity of parallel processing
software. I will describe this Python-based parallel
processing library, give examples of its use, and
compare it directly to MPI. By looking at these two
packages in parallel, I can compare such characteristics
as their capabilities, run-time performance, and ease of
programming. I will conclude with a description of
potential future directions for my work, including the
addition of new parallel processing services and
enhancements to improve efficiency.

α₁-Adrenergic specific signaling in Chinese
hamster lung (CCL39) fibroblasts.
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The activity of NHE is regulated by the action of a
wide variety of plasma membrane receptors including

Vol. 66, 2002
Abstracts

G-protein coupled receptors (GPCRs). The actions of these receptors are responsible for growth regulation and tissue regeneration. Mutations in these GPCRs have the potential to cause tumor growth and cancers. Phenylephrine (PE), an analog of norepinephrine, is used to study the adrenergic receptor pathway of NHE-1. Our experiment will test the receptor specificity of PE response. PE is added in the presence of three different inhibitors: propranolol, a β-adrenergic receptor blocker; prazosin, an α1-adrenergic receptor blocker, and yohimbine, an α2-adrenergic receptor blocker. ERK activation is measured with the goal of finding which receptor class is activated and will determine the specific receptor involved with ERK regulation.

THE EFFECT OF RATION ON CLUB CELL PROLIFERATION IN DARTERS

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Predator-prey interactions are very important in the day-to-day life of all animals, as well as being a major selective force of natural selection over time. Fishes in the superorder Ostariophysi (minnows, catfish, suckers, etc.) have special cells (club cells) in their skin that contain an alarm cue that is released when the skin is damaged by a predator. When detected, these alarm cues cause fish to exhibit anti-predator behavior. Analogous skin cells occur in darters, perch-like fishes that are not in the superorder Ostariophysi. We will compare the cell density of study fish sparsely fed with cell density of study fish abundantly fed, to determine if ration affects club cell density. We will also determine if club cell density is uniformly distributed on the back, flank, and belly of darters.

PYRUVATE,P1DIKENASE REGULATORY PROTEIN, A UNIQUE PROTEIN KINASE/PHOSPHATASE, IS LOCALIZED EXCLUSIVELY IN CHLOROPLASTS OF C3 LEAVES

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The plant enzyme, pyruvate, orthophosphate dikinase (PPDK) was first discovered as a cardinal enzyme of the C4 photosynthetic pathway. As one of the key enzymes in the pathway, it is strictly regulated by light with the enzyme being active during the day and inactive at night. This light/dark modulation is mediated by reversible phosphorylation of a threonine residue in the active-site domain by PPDK regulatory protein (RP), a bifunctional protein kinase/phosphatase. More recently, we demonstrated that RP is also present in leaves of plants possessing the C3 photosynthetic pathway and functions to regulate PPDK in similar light/dark fashion. But unlike C4 plants, PPDK in C3 plants is not involved in photosynthesis, although its function is unknown. Further, since PPDK is present in both the cytosol and chloroplasts in C3 plants, it opens the possibility that RP could also be localized in both cellular compartments. In this presentation, we demonstrate that RP is localized only in chloroplasts, which implies that only the chloroplast PPDK is light/dark regulated (inactive in the dark), with the cytosol PPDK being unregulated and perpetually active.

AN IN VITRO DEPHOSPHORYLATION ASSAY FOR C3 PLANT PPDK-REGULATORY PROTEIN, AN UNUSUAL BIFUNCTIONAL PROTEIN KINASE/PHOSPHATASE

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The pyruvate,orthophosphate dikinase regulatory protein (RP) was first discovered in C4 plants, where it strictly regulates its target C4 photosynthetic pathway enzyme, pyruvate, Pi dikinase (PPDK). RP from C4 plants has been well studied and found to be highly unique in at least three important respects. First, it is bifunctional in that it catalyzes both PPDK inactivation (phosphorylation) and activation (dephosphorylation). This is quite rare as most regulatory phosphorylation cycles have separate kinase and phosphatase enzymes. Second, it uses ADP instead of ATP as the phosphoryl donor. Third, it employs a Pi-dependent, PPI-forming phosphorolytic dephosphorylation mechanism, as opposed to simple hydrolysis as in most protein phosphatases. Recently, our laboratory has provided in vivo evidence for bifunctional RP activity in C3 plants. However, in vitro evidence has been provided only for the RP kinase function of the putative C3 RP, and not its phosphatase function. The reason for this is the technical difficulty of executing an in vitro RP dephosphorylation reaction versus the kinase reaction. To overcome these difficulties, we have developed an immunologically-based approach that utilizes phosphorylated maize PPDK as substrate. The results of this experimental approach will be presented.

INHIBITION OF MAPK ACTIVITY BY OKADAIC ACID IN SEA URCHIN EGG MICROTUBULES

Mario Fernandez and Ellen Brisch
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Microtubules (MTs) are an important cytoskeletal element found in most eukaryotic cells. MTs form the mitotic spindle that rapidly and accurately segregates the replicated chromosomes to opposite sides of the dividing cell. Biologists are intrigued as to how this process works. The study of this process is a critical area of cancer research. Cells that fail to segregate DNA into new cells will not divide. Identifying the mechanisms and targets that regulate microtubule assembly may provide new strategies for halting division in cancerous cells. MT assembly is controlled by the protein phosphorylation/dephosphorylation of MT associated proteins (MAPs). These proteins bind to, copurify with, and stabilize MTs. When MAPs become phosphorylated they lose their affinity for MTs, causing them to shrink. Thus MAPs can modulate the assembly/disassembly of MTs. Previous work has identified 44kDa and 48 kDa MT copurifying proteins as potential phosphorylation targets. The molecular weights of these proteins are suggestive of mitogen activated protein kinase (MAPK) members. These family members play important roles in growth and mitogenic (potential cancer causing)
pathways. Our goal is to determine how MAPK regulates cell division and spindle assembly by monitoring MT assembly in the presence and absence of okadaic acid, a known phosphatase inhibitor, which previously has been shown to alter MT assembly. We are interested in identifying the MAPs that this phosphatase inhibitor may protect from dephosphorylation. Using this approach we hope to identify a cell signaling regulator of MT assembly.

**Assessment of the impact of human development on the biotic integrity of lotic systems in the Lake Agassiz Plain Ecoregion**

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Biotic integrity refers to an ecosystem’s ability to maintain a community of organisms that closely resemble those that occur in natural environments. Understanding the impact of human development on the biotic integrity of rivers and streams can be critical to the preservation of natural species and their habitats. A common way to measure the biotic integrity of a lotic system is to use an Index of Biotic Integrity (IBI). An IBI uses several variables called “metrics” to measure the biotic integrity of a lotic system and assigns a numeric score. Higher IBI scores indicate a higher level of biotic integrity. This study uses an IBI prepared by the U.S. Environmental Protection Agency for the Lake Agassiz Plain Ecoregion. Indices of biotic integrity were calculated at various locations on several lotic systems in the Lake Agassiz Plain Ecoregion using data collected by the Minnesota Department of Natural Resources during the summers of 2000 and 2001. The IBI scores were calculated upstream and downstream of sites of human development on these lotic systems. The calculated IBI scores were then used to evaluate the impact that human development has had on the biotic integrity of the lotic systems.

**Compaction agent AD010835 in the purification of plasmid DNA without the use of chromatography**

Lisa Hanson1, Michelle Johnson3, Michael Chambers2, Mark A. Waller1,2, and Joseph J. Provost1,3

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Nucleic acids are often used in human vaccinations and therapeutics. For this reason DNA purification is of great importance. Commonly, RNase is used in purification of DNA but, in this case and in usage in vaccines, it is not adequate due to contaminates RNase might possess. Other methods of DNA purification are very time-consuming and may require chromatography and filtration. This procedure was done without the use of chromatography, RNase, or filtration and in a timely fashion. The secret to our method was the use of the polyanine AD010835, a cationic compaction agent that works by binding to the phosphate backbone of DNA. The actual compaction neutralizes the inter-helix interactions thereby decreasing the free energy and, thus, the transition state. By binding to the major and minor grooves, the volume occupied by DNA is dramatically reduced. AD010835’s main function is to remove the vast majority of RNA from the plasmid DNA desired and generate a small, denser form of DNA.

**Probing the unknown function of chloroplast-bound pyruvate, orthophosphate dikinase in leaves of plants with the C3 photosynthetic pathway**

Jarrod W. Heck and Chris Chastain

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Pyruvate, orthophosphate dikinase (PPDK) is an ancient plant enzyme that converts pyruvate into phosphoenolpyruvate (PEP):

\[
\text{Pyruvate} + \text{ATP} + \text{Pi} \rightarrow \text{PEP} + \text{AMP} + \text{PPi}
\]

It was originally thought to occur only in C4 plants, where it is a central enzyme in the C4 photosynthetic pathway. Later, it was discovered in plants possessing the C3 photosynthetic pathway, but in much reduced amounts. Further, the function of PPDK in C3 plants is unknown, although it does not participate in photosynthesis. Recently, we discovered that the PPDK found in chloroplasts of C3 plants is light-regulated, with the enzyme active in the light and inactive in the dark. As one means of inferring a function for chloroplast PPDK, we sought to measure the total potential activity of the enzyme per chloroplast. Using spinach as our model C3 plant, we extracted and concentrated PPDK from isolated chloroplasts and measured PPDK activity using a spectrophotometric assay. Results of these assays will compare the amount of potential PPDK activity to the scale of known chloroplast metabolic processes.

**Immunostimulatory upmodulation by a mutated Staphylococcus aureus enterotoxin encoding plasmid as an adjuvant in DNA vaccine technology**

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DNA vaccine technology is an exciting and promising new field. DNA vaccine adjuvants increase the efficacy of a DNA vaccine. Staphylococcus aureus enterotoxin C (SEC) is a well-established upmodulator of the immune system. However, due to the high toxicity of SEC, it is a poor choice as a vaccine adjuvant. A mutated form of SEC was created to reduce toxicity and obtain for its potential use in the creation of a DNA vaccine adjuvant. Here, we investigate the ability of the mutated toxin to act as an adjuvant. Mutated SEC was sublimed into a heza-histidine fusion tag construct, expressed in BL21 E. coli and purified to near homogeneity by affinity chromatography and size exclusion chromatography. The immune response of mice to ovalbumin was determined with increasing doses of the purified SEC. In addition, the mice were
Abstracts

then tested for immunostimulatory response as compared to Freund's adjuvant and an ovalbumin-encoding plasmid injection.

BUILDING A DEVICE TO TEST HUMAN SKIN CONDUCTANCE DURING FUNCTIONAL MAGNETIC RESONANCE IMAGING
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We designed a device to measure human skin conductance responses during functional magnetic resonance imaging (fMRI). fMRI is used to study correlations between a stimulus and resulting brain activity. This device consists of a Wheatstone bridge, differential amplifier, and a low pass filter. The subject is connected to the bridge circuit by a pair of electrodes attached to the subject's palm. This circuit is connected to a computer where the signal is processed. Because the MRI scanner produces higher than acceptable levels of electrical interference in a prototype circuit, we added additional amplification and filtering stages. We will demonstrate that these modifications reduce scanner interference to acceptable levels.

DISTURBANCE CUES IN AN ADULT AMPHIBIANS: XENOPUS LAEVIS
Aaron Hutcheson and Jili Greenley (Advisors: Brian Wisenden and Atoka Marasinghe)
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Chemical cues are widely used to detect the presence of predation risk. Disturbed crayfish and darter fish release urinary nitrogen and this cue is used by nearby members of their species to indicate predation risk. In this experiment, we tested to see if African clawed frogs, Xenopus laevis, secrete urinary nitrogen when disturbed. Our procedure tested for different amounts of ammonia with the frogs at rest and again when disturbed. We tested for ammonia from five frogs before and after a disturbance stimulus. If frogs use ammonia as a disturbance cue, we predict a pulse of ammonia when they are disturbed. The amount of ammonia released will then be used as a test cue in behavioral trials to confirm biological function as a disturbance cue. If so, then increased amount of ammonia will serve as a warning to other frogs of predation risk.

CELL-CYCLE COORDINATED MITOCHONDRIAL DYNAMICS
Heidi Jo Johnson, Austin McCoy, Jen Risan and Ellen Brisch
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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 the stage of the cell cycle in which they occur. 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 lead 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 led 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 testing this hypothesis by examining the following cell cycle mutants for defects in mitochondrial dynamics: cdc13 and cdc14, meiosis and sporulation; cdc 5, cdc7, and cdc15, kinases; cdc2, cdc6, and cdc9, DNA replication. The specific mechanisms of how mitochondrial dynamics are regulated during the cell cycle are beyond the scope of this project. However, by identifying cell cycle mutants with mitochondrial defects we can build a model for how mitochondrial dynamics are coordinated during the cell cycle.

PREPARATION OF 1-BROMO-2-CATECHOLBORYLETHEN FOR USE IN BORON NEUTRON CAPTURE THERAPY
Michelle Johnson, Lisa Hanson, and Gary Edvenson
Dept of Chemistry, Minnesota State University Moorhead, Moorhead, MN.

Reactions between trimethylsilylactylene, B-bromo-9-borabicyclo[3,3,1]nonane (B-Br-9-BBN) and 1-bromocatechol borane have been studied in an attempt to synthesize a boron-carbon double bond with a boron and a bromine atom cis to each other. The resulting compound, 1-bromo-2-catecholborylethane, will then be used to prepare a uracil base derivative containing a boron. The uracil nucleoside can then be tested for use in boron neutron capture therapy (BNCT), a method used to treat certain types of cancer.

CHANGES IN MAPK ACTIVITY DURING FERTILIZATION
Molly Kintop, Stephanie Peasley and Ellen Brisch
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Microtubules (MTs) are an important cytoskeletal element found in most eukaryotic cells. In dividing cells, MTs form the mitotic spindle which rapidly and accurately segregates the replicated chromosomes to the opposite sides of the dividing cell. How cells control the assembly of the mitotic spindle has intrigued biologists for many years. The study of mitotic spindle assembly is a critical area of cancer research. Cells that are unable to segregate DNA into new cells will fail to divide. Thus identifying mechanisms or targets that regulate MT assembly may provide us with new strategies for halting division in cancerous cells. Sea urchin eggs can be fertilized in vitro and will assemble MTs into functioning mitotic spindles. The regulation of MT assembly is currently thought to be controlled by the protein phosphorylation of microtubule associated proteins (MAPs). These proteins bind to, copurify with, and stabilize MTs and thus help modulate growth of MTs. MAPK is a cell signaling
protein that phosphorylates a number of cellular targets including MAPs. Immunoblot analysis of sea urchin MT protein from our lab indicates that MAPK family members copurify with MTs and may be responsible for MAP phosphorylation. Our goal is to determine how MAPK family members regulate cell division and spindle assembly by investigating changes in MT protein phosphorylation during early developmental events. Specifically, we are investigating how fertilization may regulate the activity of MAPK.

THE EFFECTS OF ANTI-CANCER DRUGS ON IRRADIATED DNA
Tammy Lien, Kim Ault, and Abbas Pezeshk
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Tamoxifen is an anti-cancer drug used to treat both advanced and early stage breast cancer. This study was designed to investigate the role of tamoxifen-damaged DNA induced by ionizing radiation. Frozen aqueous solutions of DNA were studied using indirect radiation spectroscopy. Exposure to gamma radiation at 77K resulted in the formation of guanine-center radical cations and either thymine or cytosine radical anions. Preliminary results indicate that in the presence of tamoxifen, the rate of production of primary DNA radicals significantly increased, which could lead to tamoxifen being used as a radiosensitizer.

ANALYSIS OF SNOWFLAKES AND THE ENVIRONMENTS THAT PRODUCE THEM
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A closer look at snowflake structure was undertaken for St. Cloud, MN during the winter of 2001-2002. Soundings taken for the given snow events were used to determine the different crystal habits and the environments that produced them. These soundings give a three dimensional representation of upper air elements. Soundings were taken from Aberdeen, SD; Davenport, IA; Chanhassen, MN; Bismarck, ND; and International Falls, MN. All of these were from the National Weather Service at each respective city. During the 2001-2002 winter period in St. Cloud, the number of snow events to observe were limited because of the mild winter. The presentation will focus on a period when snow fell for four consecutive days. However, this was not continuous snow. The days observed had different snowflake observations. The days were January 13th, 2002 through January 17th, 2002. The type of environment in which these crystals over the course of these days will be discussed.

PHENYLEPHRINE-INDUCED ACTIVATION OF ERK VIA THE SMALL G-PROTEIN RhoA
Andrew C. McCoy, Justin C. Voog, Hillary L. Thronson, Michelle Malott, Joseph J. Provost, and Mark A. Wаллел
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Phenylephrine (PE), an α-1-adrenergic receptor agonist, has been shown to activate both extracellular regulated kinase (ERK) and the sodium-hydrogen exchanger (NHE-1) in Chinese hamster lung (CCL39) fibroblasts. Activation of ERK, an upstream tyrosine/threonine kinase in the NHE activation cascade, can be blocked with the addition of the ROCK inhibitor Y27632. Dependence of ROCK activation mediated by RhoA is conserved in a variety of cell lines. Cycling between active, GTP-bound, and inactive, GDP-bound states, RhoA acts as a molecular switch to control a number of cellular processes including ROCK activation. Dominant-negative RhoA-transfected cells will allow translocation of RhoA to be monitored via fluorescent microscopy. To further explore PE mediated activation of RhoA, PE stimulated cells will be treated with GST-ROCK fusion protein in hopes of co-precipitation with GTP-bound RhoA. The role of ROCK and Rho and its effect on NHE activation is yet to be determined.

SOLID-STATE NMR SPECTROMETER
Brian Meland
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I have been constructing a solid-state NMR spectrometer. This device uses nuclear magnetic resonance for analyzing nuclear spectra and measuring nuclear relaxation times. It is used in studying the dynamic properties of nuclei in solids. I will show some of the work I have done in constructing the power supply, which supplies power to the entire system, and RF gating box, which creates pulses of radio waves that will put the nuclei into excited states. I will also explain some of the background information on NMR and its applications.

CREATING KNOCKOUT CONSTRUCTS IN YEAST
Anna Naig and Ellen Brisch
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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 the stage of the cell cycle in which they occur. This process is termed mitochondrial dynamics. In Saccharomyces cerevisiae, the inheritance of mitochondria from mother cell to daughter bud during cell division is 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. We are interested in understanding how mitochondrial inheritance is coordinated with the cell cycle. We plan to generate specific mutations in genes that regulate the cell cycle in yeast. Our strategy is to use a variety of molecular techniques including PCR in order to generate a “knockout” construct. We will then observe these yeast
cells by staining mitochondria and scoring their morphology. Any cells with defects in morphology will give us clues as to which cell cycle regulators control mitochondrial inheritance.

**AN ALTERNATIVE METHOD OF REGULATION FOR CITRATE SYNTHASE AND MALATE DEHYDROGENASE**
Anna Naie, Jerod Heck, and Joseph J. Provost
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According to the metabolon hypothesis, enzyme molecules non-covalently associate with one another to catalyze sequential reactions resulting in an increase in catalytic efficiency and coordination of regulation of metabolic pathways. Multi-enzyme complexes allow for the channeling of substrates between enzymes, which reduces dependence on diffusion and lowers the probability of side reactions. It has been shown that citrate synthase and mitochondrial malate dehydrogenase, which are located sequentially in the citric acid cycle, form a complex under cellular conditions. The aim of this study was to determine the effect of citric acid cycle inhibitors and pathway intermediates on formation of citrate synthase-malate dehydrogenase complexes. Citrate synthase and malate dehydrogenase were subjected to polyethylene glycol, a crowding agent, which increases the protein concentration by excluding the enzymes from the solvent, mimicking conditions within the cell. The activity of citrate synthase and malate dehydrogenase complexes was determined spectrophotometrically. Interactions between citrate synthase and malate dehydrogenase were assessed alone or in the presence of nicotinamide adenine dinucleotide, adenosine triphosphate, citrate, or oxaloacetate in order to ascertain the regulatory effects of these compounds on metabolon formation.

**PSYCHOLOGICAL AND PHYSIOLOGICAL EFFECTS OF RELAXATION MASSAGE**
Rachael Thorpe Newman
Dept of Biology, College of St Catherine, St Paul, MN

This study was designed to determine whether therapeutic relaxation massage would positively affect mood and improve physiological relaxation. Ten healthy subjects participated in four ten-minute sessions: three massage sessions and one control session. At the beginning and end of each session, the subject completed a Spellberger State-Trait Anxiety Inventory. Heart rate, respiration rate, and blood pressure (BP) were measured immediately before and after each treatment. The massage treatments included arm massage, head massage, and shoulder massage. General mood improved following shoulder massage. Finally, when comparing massage treatments versus the control, all massage treatments significantly decreased heart rate and respiration rate, and improved current mood. In addition, arm massage significantly reduced systolic BP and MAP more than the control.

**ERK-MEDIATED ACTIVATION OF THE Na\(^+\)-H\(^+\) EXCHANGER IN CHINESE HAMSTER LUNG FIBROBLASTS IS DEPENDENT UPON PHOSPHOLIPASE C\(\beta\)**
Sarah M. Olmschenk, Alison L. Metcalfe, Mingyao Liu, Joseph J. Provost, Mark A. Wallert
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The primary regulator of intracellular pH (pHi) in Chinese hamster lung (CCL39) fibroblasts is the Na\(^+\)-H\(^+\) exchanger (NHE). Various protein kinases regulate NHE, including extracellular-signal regulated kinase (ERK), which is required for phenylephrine (PE)-induced NHE activation. We are investigating how additional signaling intermediates play critical roles in NHE activation. One such molecule, phospholipase C\(\gamma\) (PLC\(\gamma\)) was examined using several different experimental techniques. Normally, 100 \(\mu\)M PE increased pH by 0.16 ± 0.03 pH units. However, in the presence of the PLC-specific inhibitors nemonoxin, Et-18-091, and U-71322, pHi increased only 0.05, 0.01, and 0.02 pH units, respectively. A concomitant reduction in ERK activity also was observed. To emphasize the role of PLC, two mutant cell lines depleted in PLC activity, 2A-4b and D1-9b, were used. Upon PE addition, pHi increased only 0.04 ± 0.02 and 0.05 ± 0.02 pH units, respectively. PE-stimulated ERK activation was also dramatically reduced in both mutant cell lines. Finally, to further confirm the necessity for PLC\(\gamma\), 2A-4b and D1-9b cells were transfected with PLC\(\gamma\) 2 and 3. Following PLC\(\gamma\) transfection, both cell types again displayed ERK and NHE activity similar to the displayed CCL39 response. This work further demonstrates the critical role of PLC\(\gamma\) in \(\alpha\)-adrenergic signaling.

**SEX-BIASED POSTNATAL INVESTMENT IN MONGOLIAN GERBILS, Meriones unguiculatus, AFTER PUP ISOLATION.**
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Female mammals usually display higher levels of care for their young than males because of high costs of gametes, internal gestation, and lactation. Moreover, because of the characteristics of mammalian mating systems, females often invest more in their sons than in their daughters due to greater variance in male reproductive success. We tested the prediction that immediately after a one-hour period of isolation, female Mongolian gerbils, Meriones unguiculatus, would invest more energy in sons than in daughters. We alternated isolating a son and daughter at the same time with isolating a son and daughter at different times to determine whether the dam showed a sex-biased
investment favoring sons. We made observations of the time required to retrieve pups after they were returned to the cage, the amount of time pups were attached to the nipple of the dam, and the amount of time pups were in physical contact with the dam. We found no significant difference between the dam's behavior towards sons and daughters. We did, however, observe some trends favoring male-biased maternal investment.

**THE PHOSPHORYLATION AND SUBCELLULAR LOCALIZATION OF FKHRL1 IN CHINESE HAMSTER LUNG (CCL39) FIBROBLASTS AFTER EXPOSURE TO ULTRAVIOLET RADIATION.**

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Cells respond to their environment by translating extracellular signals to an intracellular response in the nucleus. Intracellular signaling pathways are the link between the extracellular environments and the nucleus. Abnormalities in these signaling pathways can lead to tumorigenesis and cancer. The activation of one such pathway, the phosphatidylinositol-3-kinase (PI3K) pathway, regulates cell growth. This regulation occurs through the phosphorylation of a number of different proteins such as Akt, SGK, and FKHRL1. FKHRL1 is a transcription factor that regulates the activity of genes involved in promoting cellular death. We are interested in understanding the regulation of this transcription factor in response to cell stress stimuli such as ultraviolet (UV) radiation. The phosphorylation of FKHRL1 in response to UV radiation has yet to be examined. We hypothesize that if FKHRL1 will remain in an unphosphorylated state after UV exposure and, therefore, will remain in the cytoplasm. To test this hypothesis, CCL39 and HeLa cells transfected with a HA-tagged FKHRL1 construct will be stimulated with UV radiation. Localization of FKHRL1 will be examined by fluorescent microscopy using a fluorescent HA antibody.

**ASSOCIATIONS BETWEEN LEFT VENTRICULAR MASS, α-ADUCIN, AND SODIUM-LITHIUM COUNTERTRANSPORT IN HYPERGEN STUDY**

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Left ventricular hypertrophy (LVH), target organ damage associated with hypertension (HT), is known to develop due to the severity and duration of HT. However, normotensive individuals with a family history of HT have LVH leading to the conclusion that some nonhemodynamic factors contribute to LVH. Sodium-lithium countertransport (SLC) activity has been associated with increased LV mass and is a possible predictor of cardiovascular risk in essential HT. Polymorphisms near the α-adducin locus of the αβ-heterodimer have been associated with hypertension. In this study, an association analysis was done between LV mass and α-adducin in group hypertensive sibships. A specific association analysis was done between LV mass and SLC activity as well as SLC V_max in a group of offspring from the hypertensive siblings. In both cases, a race-specific univariate and multivariate analysis was performed. LV mass measurements were performed using 2-D pulsed doppler M-mode echocardiography and calculated using the Penn convention. Polymerase chain reaction technique was used to analyze the α-adducin G469T variant. Both SLC activity and SLC V_max were determined. In both the univariate and multivariate analysis there was no association between LV mass and the α-adducin allele. In Caucasians, the univariate analysis showed a significant association between LV mass and SLC activity and V_max (p = 0.0003 and p = 0.0317, respectively). However, after adjusting for possible confounding variables, there was no longer a significant association between LV mass and either SLC activity or V_max.
Abstracts

A WARM SURFACE AIR TEMPERATURE SINGULARITY IN LATE WINTER OVER THE NORTH CENTRAL UNITED STATES
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Recent interest in trends in climatology due to increased global mean temperatures has provided incentive and accessible data for the analysis of regional climate anomalies. A particular time of interest is around the transition of seasons from Winter to Spring. This study focuses on a February anomaly referred to as the "Termination of Hard Winter". In this study, surface air temperatures were examined for evidence of this singularity in the North Central United States. The singularity appeared as an abrupt temperature increase, centered in Northern Minnesota, which occurred around February 22 in the 24 year period 1976-1999, while occurring about a week earlier in the previous 24 year period (1952-1975). Spatial analysis suggests a tendency for changes in synoptic-scale phenomena during the 10 calendar days between February 15th and 24th. These results show an interesting change in the temperature behavior of the North Central United States over the last half-century.

THE FORMATION OF STRESS FIBERS BY PHENYLEPHRINE-STIMULATION IN CHINESE HAMSTER LUNG FIBROBLASTS.
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Actin monomers in the cytoplasm of cells polymerize forming stress fibers under a variety of culture conditions. As a component of the cytoskeleton, stress fibers play an essential role in the process of cell growth and division. The formation of stress fibers is dependent upon the activation of the small G-protein RhoA and its influence on Rock as well as the activation of the Na-\(^+\)H\(^-\) exchanger (NHE). The primary role of NHE is to control intracellular pH. Thus the activation of both RhoA and NHE is required for stress fiber formation. The lipid agonist lysophosphatidic acid (LPA) has the ability to initiate the formation of stress fibers in Chinese hamster lung (CCL39) fibroblasts. Building on this knowledge, we sought to demonstrate a novel role for phenylephrine (PE) stimulation in this same process, which our laboratory recently showed stimulated NHE activity in these cells. To test PE's ability to stimulate stress fiber formation, CCL39 fibroblasts were incubated with 100 \(\mu\)M PE. Stress fiber formation was measured using fluorescent labeled phalloidin. Micrographs of cells with and without PE treatment were then made. Stress fibers could be seen at a much higher density in PE-treated cells than in untreated cells. This conflicts with past data dealing with Gq, the G-protein that initiates the PE pathway. Because the pH level of a cell is a known factor of stress fiber formation, we used PS127 cells, which overexpress NHE, and PS120, which lack the exchanger, to attempt to determine the link between stress fibers and intracellular pH.

A PREDICTABILITY STUDY EMPLOYING A NON-DIVERGENT BAROTROPIC VORTICITY MODEL
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A predictability study was conducted employing a non-divergent barotropic vorticity model. This model simulated the atmosphere as a one-layered, non-divergent fluid with no friction, moisture, or diabatic heating. Under these conditions the absolute vorticity, or microscopic rotation, was conserved. The resulting model was not only easy to create, but the variance in the final state of the model runs can be traced solely to the differences in the vorticity field at the initial time. The barotropic model was initialized with upper air observations collected across North America on 00 UTC 6 December 1996. These data were integrated in time to obtain a forecasted data field. The control field was then compared with other data fields in which observations had been removed, thus altering the initial state of the model. The results demonstrate that some observations carry more weight than others in determining a model forecast. This has many applications to operational meteorology. For example, limited observations over regions like the ocean could be deployed to better resolve features that have a high degree of impact on the model forecast. This, in turn, would improve forecast skill.

SEASONAL ACCLIMATION OF LEAF ANTIOXIDANT SYSTEMS IN THE EVERGREEN Taxus cuspidata GROWING IN SUN VS SHADE
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Seasonal changes in levels of the antioxidant metabolites, ascorbate and glutathione, were measured in the evergreen Taxus cuspidata growing in both low and high light environments. One of the functions of ascorbate and glutathione is in scavenging active oxygen produced during photosynthesis in the ascorbate/glutathione cycle. The goal of this study was to determine the role of these antioxidants in the plants' ability to acclimate to excess light during periods of decreased photosynthesis due to low temperatures. The results to date indicate that, during the winter, there were significant increases in glutathione level, but no (or only slight) increases in ascorbate level in both low and high light environments. The data for low versus high light environments demonstrate a significantly higher amount of ascorbate in the high-light grown plants in both summer and winter. Glutathione levels were higher in high versus low-light plants in summer, but not in winter. The data are interesting because of the variation in the responses of the two antioxidants, both to winter and light stress. The data suggest no, or a limited, role for ascorbate in acclimation to the increased excess light occurring during winter stress. The data suggest a role for glutathione in acclimation to winter stress that is distinct from the ascorbate/glutathione cycle and that is independent of light environment.
EXAMINING THE ROLE OF THE ACTIN CYTOSKELETON IN MITOCHONDRIAL MORPHOLOGY AND INHERITANCE.
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The mitochondrion is a complex organelle with a double membrane, its own genome, and separate protein synthetic machinery. In the budding yeast, Saccharomyces cerevisiae, mitochondria are transferred from mother to daughter cell during budding through a process termed mitochondrial inheritance. In wild type cells, mitochondria form a long, tubular, branched network. There is evidence that the actin cytoskeleton is crucial in maintaining mitochondrial morphology and inheritance during vegetative yeast cell growth. Numerous actin mutants have been identified that display abnormal mitochondrial morphology and inheritance. The actin related protein 2/3 complex (Arp2/3) is a septamer of highly conserved, distinct polypeptide subunits. The Arp2/3 complex has been shown to nucleate actin polymerization at membranes. This polymerization has been implicated in mitochondrial movement. In fact, two mitochondrial membrane proteins, Mmt1p and Mdm10p, also are required for association of the Arp2/3 complex with mitochondria. It is our contention that mutations to the different subunits of the Arp2/3 complex will result in aberrant mitochondrial morphology and inheritance. By creating yeast mutants lacking subunit(s) of the Arp2/3 complex and examining them by immunofluorescent microscopy, we will screen for abnormal mitochondrial morphology and inheritance. This may provide insight into the role of the Arp2/3 complex in mitochondrial motility and morphology.

SEASONAL VARIATION IN ANTIOXIDANT ACTIVITIES OF APX, GR, AND SOD IN THE EVERGREEN TAXUS CUSPIDATE GROWING UNDER SUN AND SHADE
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The antioxidant activities of superoxide dismutase (SOD), ascorbate peroxidase (APX), and glutathione reductase (GR) were studied in the evergreen Taxus cuspidate growing in different light environments during summer and winter. Leaf antioxidant activities were generally higher in sunny areas compared to shaded areas; however, response to winter stress was variable. SOD activity per g fresh weight and per g protein exhibited higher activities in summer under areas of sun compared to sun-exposed areas in winter and with no significant differences in the shade. However, there was no evidence for upregulation of SOD in the antioxidant pathway during winter when plants were exposed to increased light. Average APX activity per g fresh weight and per g protein appeared slightly higher in winter than in summer, though there were no significant differences in both sun and shade. Average GR activity per g fresh weight and per g protein was significantly higher in winter compared to summer in both sun and shade. This significant increase in GR activity observed in winter in both sun and shade, as seen in earlier studies, possibly suggests that either GR was performing multiple functions besides its role in reducing glutathione in the ascorbate-glutathione cycle or that cellular demands for reduced glutathione may also have caused GR activity to increase.

NOCTURNAL ASSESSMENT OF PREDATION BY ZEBRA DANIOS (DANIO RERIO)
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Nocturnal antipredator behavior of zebrafish (Danio rerio) was studied to ascertain information about nocturnal behavior in response to alarm substance and the odor of pike (Esox lucius). Northern pike are not natural predators of the zebrafish, which makes the pike a good test subject since their chemical cues are completely novel to the zebrafish. Testing was conducted using a camcorder with night vision to detect the movement according to a quantifiable grid system. Each trial tested one pair of fish. Two aspects of antipredator behavior were measured: vertical distribution and horizontal activity. On day 1, fish were conditioned with a combined cue of alarm substance and pike odor or water and pike odor. On day 2, the same fish were retested with pike odor only. On day 1, there was no significant change in vertical distribution or horizontal activity of fish tested with alarm substance/pike odor or water/pike odor. On day 2, fish conditioned with alarm substance/pike odor did not significantly increase time near the bottom when re-exposed to pike odor but they did show a significant increase in horizontal activity relative to fish that were previously conditioned with water and pike odor. These data indicate that zebrafish and pike have learned to recognize the chemical identity of nocturnally active predators even during times of their own inactivity.

PROGRESS TOWARDS ENHANCING THE SURVIVAL RATE OF HATCHERY-REARED WALLEYE
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Aquatic prey recognize injury-released chemical alarm cues from their own species as an indicator of predation risk. Predator recognition is acquired by associating predator cues (e.g., its odor) with injury-released alarm cues. This phenomenon has been well established for percids (darters), ostariophysans (minnows), and aquatic invertebrates. Hatchery fish are stocked into lakes to enhance local fisheries. However, they are predator-naive. Losses to predation of hatchery-reared fish typically exceed 50% in the first year after stocking. The walleye (Stizostedion vitreum vitreum), native to Midwestern water bodies, falls into this category. In a previous project, we found that walleye possess specialized skin cells similar to the ones that contain alarm cues in minnows. We also demonstrated that an aversive behavioral response to injured walleye skin occurs. Therefore, a continuation of tests was performed to see if juvenile walleye can associate walleye alarm cues from these specialized skin cells with the odor of northern pike (Esox lucius), a natural
Abstracts

In our experiment, the behavioral response to conspecific alarm cue and the learned response to predator odor were not consistent. Consequently, statistical analysis did not reveal significant effects of alarm or predator cues on walleye behavior. The experimental protocol needs to be modified to better accommodate walleye behavior in captivity in order to better test our question.

Lysophosphatic acid (LPA) and phenylephrine (PE) produce different effects on the activation of Na+/H+ exchanger in Chinese hamster lung (CCL39) fibroblasts

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Intracellular pH (pH_i) is regulated almost exclusively through the Na+/H+ exchanger (NHE) in CCL39 fibroblasts. LPA and PE, the α1-adrenergic agonists, have been shown to activate NHE, but the entire signaling pathway has yet to be determined. In CCL39 fibroblasts, resting pH_i was 6.93 ± 0.09. Upon addition of 100 mM LPA, pH_i increased by 0.47 ± 0.06. Upon addition of 100 μM PE, pH_i increased by 0.15 ± 0.02. These experiments were done by blocking MEK using PD98059 or dominant negative MEK which reduced PE activation by 80% and LPA activation by 45%. We also investigated PE/LPA additivity in activation of NHE. When LPA was added first, pH_i increased by 0.53 ± 0.06 units. Subsequent PE addition only increased pH_i by 0.02 ± 0.02 units, resulting in a total stimulation of 0.55 ± 0.06 units. Conversely, when PE was added first, pH_i increased by 0.14 ± 0.04 units. Subsequent LPA addition caused pH_i to increase only 0.40 ± 0.04 units, resulting in a total pH_i increase of 0.54 ± 0.08 units. Data from both additivity experiments suggest that there exists a common aspect of intracellular signals used by PE and LPA. However, LPA also uses a second signaling pathway. Immunokinase assays of PE- and LPA-stimulated cells showed an additivity of ERK activation by the agonists. ERK activation alone is not sufficient for full NHE activation. (This work was supported by an NSF grant, MCB-0080243.)

Circadian function and pacemaker resetting in mPer2 knockout mice.

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In mammals, a circadian pacemaker in the hypothalamic suprachiasmatic nucleus (SCN) drives all daily oscillations of physiology and behavior. Recent discoveries have identified several circadian “clock” genes that are critical to the function of this pacemaker. The genes Clock, BMAL1, Cryptochrome and Period (mPer1, 2 and 3) appear to constitute a 24-h negative feedback loop within SCN neurons. mPer1 and mPer2 are also induced by retinal illumination and may be necessary for the pacemaker synchronization to environmental light-dark cycles. We are investigating the functional importance of the mPer2 gene within the mammalian circadian pacemaker and photic entrain-
THE RELATIONSHIP BETWEEN ALARM CUES AND THE APPROACH OF A VISUAL PREDATOR IN A PREY SPECIES
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Aquatic animals assess predation risk through chemical cues and visual information. Here, we test the effect of chemical alarm cues on the behavioral response to visual presentation of a model predator. Alarm cue was prepared from cyprinid skin extract. Alarm cue is released when prey fish are injured in an attack by a predator; thus, it reliably indicates the presence of predation risk. First, we observed 5 min of pre-stimulus behavior. Then, 60 mL of alarm cue (or water control) was injected through a submerged hose for 1 min. This was followed by 2 min of post-stimulus observations. A model predator was then pulled through the area where the alarm (or water) cue was released along its path in front of the camera; this took an average of about 10 sec. Finally, a 3 min post-predator observation was taken. We found that the number of minnows in view of the camera was significantly less following the injection of alarm cue and that this response mirrored the response of the control trials to the presentation of the model predator. These data confirm the ecological role of chemical alarm cues.

NOTICE

A single issue of The Journal of the Minnesota Academy of Science will be published annually. This issue will continue to publish abstracts for 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.

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