

4-25-1997


**Program Abstracts, 109th Session, Iowa Academy of Science,
April 25-26, 1997**

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**PROGRAM ABSTRACTS
109th SESSION
IOWA ACADEMY OF SCIENCE**

**April 25-26, 1997
Clarke College, Dubuque**

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AGRICULTURAL SCIENCES

1. Risk assessment studies on rose rosette disease-augmented multiflora rose plots

A. H. EPSTEIN, J. H. HILL, & J. ROHOZINSKI

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Incidence of rose rosette disease infection in stands of multiflora rose augmented with rose rosette disease in 1993 exceeded 96% of the ambient multiflora rose plants in the stand by the end of 1995. Over 92% of the infected (symptomatic) plants in these stands were supporting elevated populations (average of 7 mites per leaf axil) of the eriophyid mite-vector (*Phyllocoptes fructiphylus*) in mid June 1996. Infection of ornamental cultivars occurred in risk assessment plots located at distances of 2.5 meters from symptomatic, mite-infested multiflora rose, but no infection was seen in plots located at 20 meters or beyond. Total mite population was estimated to be the highest it has been since the plot was augmented in 1993. However, movement of the mites, out of the plot, as evidenced by RRD infection in the ornamental rose cultivars in the risk assessment plots, did not occur. Movement of the vectors out of the augmented plot appears to have been hampered by a lack of "carrier arthropods."

Research on the identification and characterization of the causal agent of rose rosette disease at the molecular level has commenced, using two approaches: 1) We have extracted two species of single stranded RNA that are disease specific, and can be extracted in large amounts from both leaves and apical buds of infected plants, and 2) We are attempting to identify what appear to be disease specific proteins extracted from infected plants.

2. Agronomic responses of soybeans to swine manure

L.M. HEDRICK, D.A. REYNOLDS, C.A. MARTINSON, & G.L. TYLKA

Dept of Plant Pathology, Iowa State Univ, Ames, IA 50011

Recent expansion of swine production on individual farms has forced farmers to apply animal wastes to land before soybean production. Swine manure has been reported to increase soybean yield. Liquid swine manure (or inorganic fertilizers with equivalent N, P, and K availability) was applied to soil in bands or broadcast, and then incorporated. With band incorporation, soybeans were planted either over

or between the bands. Manure was applied at rates of 0, 3,000 and 6,000 gallons per acre. Five sites were employed.

Planting over bands of manure or inorganic fertilizer resulted in reduced stands, especially at the higher rate. Soybeans growing in plots amended with manure or fertilizer were taller than soybeans in untreated soil. The manure and fertilizer treatments did not increase or decrease soybean yields compared to soybeans growing in untreated soils. Evidently, swine manure applied at the rates used in this study does not provide a significant fertilizer benefit to soybeans in highly fertile Iowa soils.

3. Population of *Melampsora medusae* on *Populus* in Iowa changes since 1992

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¹Depts of Forestry & Plant Pathology, Iowa State Univ, Ames, IA 50011; and ²Algona High School, Algona, IA 50511

In biomass plantations of *Populus*, the dominant pathotype of the leaf rust, *Melampsora medusae*, changed in Iowa since 1992. At that time the dominant pathotype did not produce disease reactions with differential clone 57-276, a University of Washington hybrid of *P. trichocarpa* X *P. deltoides*. A rust isolate was found, but rarely, reacting with this *Populus* clone. *M. medusae* was reported in 1991 as common and serious for the first time on *P. trichocarpa* based hybrids, similar to clone 57-276, in commercial plantations in the Pacific Northwest. Beginning in 1994, in Iowa, *M. medusae* began to be found commonly on field plantings in Iowa on clone 57-276. Pathotypes with this pathogenicity became dominant in Iowa during the 1996 growing season.

4. Microbial colonization of corn roots following monoculture and crop rotation

H.D. SHAFFER & G.P. MUNKVOLD

WITHDRAWN BY AUTHOR

5. Plant density influence on selection efficacy in corn (*Zea mays* L.)

M.J. CARENA SONZINI & I. SANTIAGO

Dept of Agronomy, Iowa State Univ, Ames, IA 50011 (Sponsored by CONICOR [Argentina])

Breeders usually select at only one environment. Successful breeding programs, however, may be limited by this cause.

Modern hybrids are the result of genetic as well as environmental improvement. Plant density is one of the most important environmental factors that is responsible for corn yield production. Besides, it is a factor that can be easily changed with the purpose to select superior genotypes. However, its use as selection environment has been ignored.

The main objective of the research was to evaluate the environmental influence on three cycles of recurrent selection in the synthetic variety AS-Z. Results of three-year research will be discussed.

6. Oats overseeded into soybeans as a fall cover crop

T.J. JOHNSON, T.C. KASPAR, & K.A. KOHLER

USDA-ARS National Soil Tilth Lab, 2150 Pammel Drive, Ames, IA 50011

Fields that have been in soybeans (*Glycine max* L.) are at a great risk for erosion after harvest. An oat (*Avena sativa* L.) cover crop has the potential to reduce soil erosion following soybean when over-seeded in late summer. There is concern that yields of both soybeans and the subsequent corn crop will be reduced by the oat cover crop. A study was conducted from 1991 to 1996 to examine the effect of the oat cover crop on soybean and corn yields. Overseeding oats into soybeans resulted in no significant difference in soybean yields in all but one year of the study. The corn yields in the subsequent season were not significantly different. The accumulation of dry matter by the oats will also be discussed.

7. Optimal plant density and row configuration for strip intercropped maize

M.M. HARBUR, R.M. CRUSE, & M. GHAFARZEDEH

Dept of Agronomy, Iowa State Univ, Ames, IA 50011

Strip intercropping maize (*Zea Mays* L.), soybeans (*Glycine Max* L. Merrill), and small grains is a developing practice which could both increase maize yields and decrease erosion.

Plant density and row configuration recommendations are available for sole cropped maize, but not for maize cultivated in narrow strips. More solar radiation is available to the outer rows of a maize strip than is normally available to sole cropped maize. Maize grown with higher populations in the presence of higher sunlight levels seem to boost yields and thus make this system even more attractive to growers.

Recent research will be discussed.

8. Model for economic analysis of fungicide usage in hybrid corn seed production

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Dept of Plant Pathology, Iowa State Univ, Ames, Iowa 50011

A model was developed and used to determine the economic benefits of using fungicides to control foliar fungal diseases of seed corn in Iowa. The components of the model are: 1) increased income to the seed company due to fungicide usage, based on a wholesale price of \$30 per bag of seed and a premium of \$2 per bag of medium sized seed, and 2) increased expenses incurred by the seed company, calculated as the sum of fungicide and fungicide application costs, cost of processing increased seed, and increased payment to the grower by the seed company. Increased payment to the grower was calculated as the product of increased seed yield (before separation into fractions) from fungicide usage, May futures price for No. 2 commercial corn, and an average inbred production factor. Increased net return to the seed company was calculated by subtracting increased expenses from increased income. A net profit to the seed company of up to \$884/acre (\$2184/ha) was realized from fungicide usage. Payment to the grower increased by up to \$68/acre (\$168/ha). On the basis of net returns calculated by using the model, 64% and 79% of 169 fungicide treatments applied to experimental plots in commercial hybrid corn seed production fields in 1990-93 resulted in a net profit to the seed company and to the grower, respectively. The results from this study indicate that in the presence of foliar diseases, application of fungicides can reduce crop loss and increase profit in hybrid corn seed production.

9. Disease stress, photosynthetic sinks, and foliar disease tolerance in maize

C.A. MARTINSON

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Tolerance is the ability of a plant to yield well in spite of being severely diseased. The severity of maize stalk rot is related to environmental stresses that limit photosynthesis, e.g. foliar diseases, after kernel set has been determined. The developing kernels are the primary sink for photosynthates. When photosynthates become limiting, translocation of available photosynthates to the kernels causes the stalks and roots to be deficient in carbohydrates; this leads to cell death in the stalks and roots and predisposition to stalk rot development. Stalk death stops translocation of photo-

synthates to the kernels. Maize genotypes differ in the ability to resist this predisposition to stalk death. The proposed tolerance concept is that varieties with resistance to early stalk death have tolerance to the foliar diseases.

Eight varieties of maize were investigated for their yield responses and stalk death in the presence and absence of gray leaf spot and also with gradual mechanical defoliation, which imitated loss of photosynthetic leaf area during a severe gray leaf spot epidemic. The tolerance concept proved correct as resistance to early stalk death was related to reduced yield losses to gray leaf spot and defoliation.

10. Intermutants of maize endosperm starch: Effects on starch biosynthesis and potential utilization

E.P. WILHELM & P.L. KEELING

ExSeed Genetics LLC, Iowa State Univ, Ames, IA 50011

Genetically modified starches of maize endosperm are already important to the starch industry. We expect these starches to become even more vital as novel starches which reduce processing costs or are useful in new industrial, food, and feed applications are discovered. Maize starch intermutants, defined as having endosperm tissue containing one or two doses of two mutant alleles, have recently been found to produce unique starches valuable to the starch industry.

The objective of this report is two-fold. First, to review the development of genetically modified starches, their uses, and the accompanying biochemical changes from which novel starches arise. Secondly, to discuss a study currently underway involving all possible crosses of waxy, amylose extender, dull, sugary-2, and wild type plants of a single maize inbred. Our studies will focus on how these crosses affect the activity of twelve enzymes in the starch biosynthetic pathway of the resulting endosperm tissue.

POSTERS

11. Effects of herbicides on growth of *Fusarium solani* and on severity of sudden death syndrome in glyphosate-resistant soybean

C.M. PETERS, H. SCHERM, & X.B. YANG

Dept of Plant Pathology, Iowa State Univ, Ames, IA 50011

Four post-emergence herbicides (imazethapyr, pendimethalin, lactofen, and glyphosate) were evaluated for their effects on growth and reproduction of *Fusarium solani*, causal agent of sudden death syndrome (SDS) of soybean. The herbicides significantly affected radial growth of the fungus on potato dextrose agar (PDA). Mean colony areas were 18.6 cm² for the control, and 16.7, 14.6, and 7.4 cm² for PDA amended with glyphosate (active ingredient of Roundup) at 1, 2, and 10 times the labeled application rates, respectively. Although the herbicides significantly affected spore production, the nutrient level of the culture medium (PDA at 3.3, 33.3, or 100% concentration) accounted for most of the variation in this variable, with the number of spores per unit area being greatest on 100% PDA. Effects of herbicides on SDS severity on a glyphosate-resistant soybean cultivar and on a standard cultivar were evaluated by applying herbicides 18 days after planting in soils inoculated with *F. solani* in a growth chamber. Soybeans treated with glyphosate had significantly greater SDS severity than untreated soybeans or those treated with other herbicides, suggesting a predisposition effect of glyphosate. Rate of application (1 or 2 times the labeled rate) did not affect disease severity significantly.

12. An investigation into the nodulation status of ornamental woody legumes, *Cladrastis kentukea* (Dum.-Cours.) Rudd (American yellowwood) and *Sophora japonica* L. (Japanese pagodatree)

C.M. FOSTER, W.R. GRAVES, & H.T. HORNER

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Insight into the nodulating behavior of woody legumes is important for their use in agriculture. The nodulation status of closely related ornamental woody legumes, *Cladrastis kentukea* (Dum.-Cours.) Rudd (American yellowwood) and *Sophora japonica* L. (Japanese pagodatree), is uncertain. Our objective was to verify further that *Cladrastis kentukea* does not nodulate and to confirm unsubstantiated reports that *Sophora japonica* does nodulate. Broad range rhizobia, soil and rhizobial isolates from closely related *Sophora*

spp., and soil from mature *Cladrastis kentukea* and *Sophora japonica* were used to inoculate 5 day-old *Cladrastis kentukea*, *Sophora japonica*, and control seedlings. Inoculated and uninoculated plants were grown in Leonard jars or clay pots containing perlite and irrigated with 25% nitrogen-free Hoagland's solution. After 7 weeks in the greenhouse, roots were examined for nodules. We found that the inoculation treatments did not elicit nodulation in *Cladrastis kentukea* or *Sophora japonica*. Isolating compatible symbionts and understanding factors that lead to or prevent nodulation are steps toward using nitrogen fixation for sustainable nursery production and tree survival in harsh landscapes.

13. Oats overseeded into soybeans as a fall cover crop

L.J. JOHNSON, T.C. KASPAR, & K.A. KOHLER

USDA-ARS National Soil Tilth Lab, 2150 Pammel Drive, Ames, IA 50011

Fields that have been in soybeans (*Glycine max* L.) are at a great risk for erosion after harvest. An oat (*Avena sativa* L.) cover crop has the potential to reduce soil erosion following soybean when over-seeded in late summer. There is concern that yields of both soybeans and the subsequent corn crop will be reduced by the oat cover crop. A study was conducted from 1991 to 1996 to examine the effect of the oat cover crop on soybean and corn yields. Overseeding oats into soybeans resulted in no significant difference in soybean yields in all but one year of the study. The corn yields in the subsequent season were not significantly different. The accumulation of dry matter by the oats will also be discussed.

ANTHROPOLOGY

14. The Yorùbá concept of health and well-being: implications for Nigerian national health policy

D.M. WARREN

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This study, based on research conducted in Nigeria during summer 1996, explores from an ethnoscientific approach the broad range of emic concepts used to construct the knowledge base for defining wellness and well-being for the Yorùbá of Nigeria. Yorùbá knowledge (Imò Yorùbá includes Yorùbá knowledge of health and well-being (Imò àlàáfíà Yorùbá), an indigenous therapeutic system that is holistic, encompassing physical health as well as social, cultural, psychological, and spiritual aspects of

well-being. An understanding of indigenous therapeutic systems has important implications for sustainable, cost-effective approaches to national health delivery.

15. The Yoruba Egungun of Nigeria: A video ethnographic case study of how the Yoruba define well-being

M. VISANI

Dept of Education, Iowa State Univ, Ames, IA 50010

This study is based on Nigeria's traditional Yoruba culture. It specifically focuses on the healing aspects of the annual ancestral Egungun festival using video as a means of documenting indigenous knowledge. An introduction to the present state of video production is followed by a general description of Egungun and how it relates to Yoruba perceptions of well-being (alaafia). The Yoruba belief system of traditional medicine (oogun ibile) through the life cycle is examined. Egungun, an essential part of the Yoruba belief system, exemplifies the healing aspects of oogun ibile and the maintenance of the life cycle.

An investigation of Egungun focusing on the events related to individual and community well-being is discussed. This includes background information on the traditional Yoruba belief system and a description of the festival's activities. This includes Egungun masquerades showing their power through acrobatic feats, flogging exercises, and ritual dances. Other Egungun show their power using herbs to cure illnesses.

The study gives a detailed account of the methodology used to collect data. An equipment list is followed by the documentation process, which includes complete video and audio recordings of events surrounding Egungun. Specifically, the section describes the various media and process used to document information. This includes video interviews, video performances, photography, artwork, and audio recordings.

16. The role of ancestors in the promotion of individual and community well-being among the Yoruba of Nigeria

N.H. WOLFF

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The Egungun masqueraders of the Yoruba are embodiments of the ancestral spirits who take an active role in ensuring the well-being of community and individuals. In their intermediary role between the deities and the living, the ancestors can bring blessings, good luck, children, and good health, but also can punish wrong-doing. Those men who take up

the masquerade are experts in the special medicines to call upon the powers of the ancestors to cure illness, to give children to the barren, or alternatively to cause sickness, mental illness, and lack of success in life. The annual festival of the Egungun described here is a time when personal crisis is addressed and community well-being assured.

17. The impact of weaving on the health and well-being of the Yoruba of Nigeria

B. WAHAB

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The handwoven cloth (*aso oke*) of the Yoruba of southwestern Nigeria is an important cultural artifact symbolizing purity, holiness, wealth, value, social behavior, power, prestige, wellness and well-being. The handwoven cloth produced by both males and females promotes economic well-being and constitutes an important therapeutic link between social, psychological, spiritual and physical well-being of the people. As this study noted, however, its production is associated with injuries to the wrist joints, abrasions on palms and fingers, skin and eye irritations, backache and bursitis.

18. Indigenous Yoruba sanitation knowledge systems and primary health care in Nigeria

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Primary health care (PHC) has been endorsed by the Nigerian National Health Policy and the World Health Organization. Personal hygiene and environmental sanitation are fundamental to PHC. Indigenous sanitation knowledge systems (*imototo*) suited to local needs and conditions have been evolved by local populations as an integral part of health care and an indispensable part of any PHC program. Sanitation planning is an integral part of the traditional Yoruba community. Traditional settlement planning involved such aspects of sanitation as siting of refuse dumps, waste recycling, construction of drainage ditches, and control of epidemics. This study on the Yoruba of Nigeria observes that indigenous sanitation knowledge systems constitute the foundation for community environmental planning and management essential for sustainable and healthy living environments.

19. Dance therapy in traditional Yoruba culture

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Dance has been acknowledged by anthropologists as one of the principal artistic activities in many areas of the African continent. The role of dance as a component of religious ceremony has been briefly discussed. Here we examine the role of dance as a physical and psychological method of healing in traditional medicine.

Dance is examined as a method of increasing familial ties, healing physical ailments with the use of traditional herbs, and preventing or repairing psychological ailments. Research is conducted from an emic perspective, including interviews from field research with healers, dancers, and laypersons. All information obtained refers to the concept of *aalafia*, an encompassing term meaning overall good health, well-being, or peace of mind.

The ultimate goal is to use the information to develop alternative therapeutic practices in the US. The author proposes programs to integrate the *aalafia* concept into established therapeutic methods and as an educational tool.

20. Late Woodland faunal exploitation as viewed from a Dubuque-area rock shelter

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The Carroll Rock Shelter (13DB486) is located just south of Dubuque, Iowa, and was the recent subject of limited archaeological excavation. The site includes several stratified components, but the most interesting material to date came from a single feature relating to the locally defined Late Woodland Keyes phase. The feature yielded a tight material association including diagnostic ceramics, arrow points, a large mixed faunal assemblage with a major constituent of bison, and useful archaeobotanical remains, all radiocarbon dated to A.D. 910, uncorrected. The significance of the data will be discussed with particular emphasis paid to the bison assemblage.

21. An archaeological survey of Union Park Hollow, Dubuque, Iowa

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The alignment of the proposed extension of Dubuque's Northwest Arterial highway lies in Union Park Hollow in the northern part of the city. An archaeological survey of the proposed route encountered a complex of prehistoric and historic archaeological remains in the lower reach of the hollow. The prehistoric remains represent Late Woodland period occupations on late Wisconsinan age Savanna Terrace remnants. The historic period remains and features occur on both late Wisconsinan and Holocene landforms. Historic period remains date as early as the 1830s and extend through the late twentieth century.

Features representing residential, agricultural, commercial, recreational, and transportation uses of the hollow were encountered.

22. The recovery of a Paleoindian Gainey type fluted projectile point from the Wolters site, 13DB512, Dubuque County

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During the 1996 survey of a proposed borrow area for the reconstruction of US 52 in Dubuque County, a fluted projectile point base was recovered from the pasture covered surface of the Wolters site. Analysis of the point base indicated a likely affiliation with Gainey type fluted points from the Paleoindian period. These points were originally described as a result of research at the Gainey site, 20GS49, located near the center of Michigan's lower peninsula. A Gainey-like complex including Gainey type fluted points has also been identified in Wisconsin. This paper will review the Wolters site as a whole, describe the Gainey type projectile point recovered at the site, and discuss the presence of fluted Paleoindian projectile points in northeast Iowa.

23. Summary of data salvaged from Buck Creek Mound 1, Clayton County, Iowa

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The Buck Creek Mounds formerly overlooked the Mississippi River near Guttenberg, Iowa. The mounds

were excavated under salvage conditions in 1979 during construction of a segment of the Great River Road, but excavation results remained unanalyzed until 1995. Analysis of Mound 1 data is presented, providing new information concerning burial practices during the Woodland period in the upper Mississippi River valley.

24. Cultural Continuity in the Welsh diaspora: traits, boundaries or schema?

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Previous research by Caulkins and Trosset indicates considerable continuity between behavior identified as "Welsh" by residents of Wales and by Iowans of Welsh ancestry. This continuity is not on the level of overt Welsh "traits" associated with music, cuisine, or ritual, often considered markers of ethnic identity, or with boundaries between groups. Instead, the continuity between the home country and the Welsh diaspora is in the transmission of cultural schema. These schema, or cognitive models for behavior, are not necessarily conscious or necessarily associated with Welsh identity. To the degree that they are consciously recognized models, they may be associated with family traditions instead. These schema and the processes by which they are generated are illustrated through interviews with Welsh-American families in Iowa.

25. Using the Human Relations Areas Files in anthropological research

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The Human Relations Areas Files 60-Society Cross-Cultural Probability Sample CDs were designed to "encourage and facilitate the cross-cultural study of human culture, society, and behavior" (HRAF Users Guide 1995). The Probability Sample CDs consist of thousands of entries on a limited number of topics for 60 societies. These CDs are significantly easier and faster to use than the traditional microfiche HRAF files and represent a random sample of societies. Entries in this database are "snippets," ranging from sentences to paragraphs, on a given topic. This information can be accessed through "keywords" or through the use of specific codes assigned to topics and societies.

There are numerous applications for these materials. We designed ways to incorporate them into our courses where they would supplement material introduced in class and provide students with the

opportunity to gain hands- on experience in cross-cultural research. In a tutorial taught by the first author for first-year students, students read about a study involving extensive cross-cultural research into human mate choice mechanisms. This section of the course was designed so that we would discuss one or two book chapters on Thursday, determine what factors the author examined, and ascertain for what indicators the students would search in the HRAF files. The students then scrutinized "their" societies' data (each was assigned three cultures) and we compiled and discussed their data on the following Tuesday to determine whether the author's work had been supported. Two papers resulted from this research and have been submitted for presentation at the IAS Meetings. The HRAF data are thus both a unique classroom tool and offer an opportunity for students and professors to collaborate on meaningful research.

26. What males want: an evolutionary perspective

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According to Darwin's (1859) theory of evolution, his discussion of sexual selection (1871), and the subsequent refinement of our understanding of these processes through the work of Trivers (1972) and others, there are basic differences between males and females in how they pursue reproductive success and the strategies they use to do so. Buss (1994) has investigated these differences between human males and females and describes the evolved psychological mechanisms behind human mating strategies in his book *The Evolution of Desire*. Buss obtained his data on "what males want" through systematic questionnaires administered in 37 societies to 10,000+ individuals. We replicated Buss' study utilizing data available in the Human Relations Area Files 60-Society Cross-Cultural CD's. We collected data on five factors ranging from beauty to virginity which Buss' study indicated were important criteria males used in evaluating and choosing a mate. Using a 75% agreement rate as our criterion for "support" of Buss' work, we found that our data corresponded with that of Buss with only one exception - the importance of virginity.

We see this lack of correspondence for this factor as an important exception in need of further explanation. The virginity factor can have crucial reproductive consequences for the male, and its importance should, therefore, be evident in the cross-cultural data. Our preliminary results indicate that there may be "exceptions to the rule" based upon

cultural factors such as emphasis on the role of the biological father vs that of a "cultural" father - i.e. *pater* vs *genitor*. Thus our study, while providing further evidence for these evolved mechanisms, also shows that these mechanisms are moderated by cultural factors.

27. What females want: an evolutionary perspective

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According to Darwin's (1859) theory of evolution, his discussion of sexual selection (1871), and the subsequent refinement of our understanding of these processes through the work of Trivers (1972) and others, there are basic differences between males and females in how they pursue reproductive success and the strategies they use to do so. Buss (1994) has investigated these differences between human males and females and describes the evolved psychological mechanisms behind human mating strategies in his book *The Evolution of Desire*. Buss obtained his data on "what females want" through systematic questionnaires administered in 37 societies to 10,000+ individuals. We replicated Buss' study utilizing data available in the Human Relations Area Files 60-Society Cross-Cultural CD's. We collected data on ten factors ranging from ambition to resources which Buss' study indicated were important criteria females used in evaluating and choosing a mate. Using a 75% agreement rate as our criterion for "support" of Buss' work, we found that our data corresponded with that of Buss with only three exceptions - age, commitment, and dependability/stability.

We see this lack of correspondence for these three factors as important exceptions in need of further explanation. The commitment and dependability/stability factors have crucial reproductive consequences for the female, and their importance should, therefore, be evident in the cross-cultural data. Our preliminary results indicate that there may be "exceptions to the rule" based upon cultural factors such as a female's access to resources other than those provided by her mate. Thus our study, while providing further evidence for these evolved mechanisms, also shows that these mechanisms are moderated by cultural factors.

BOTANY

28. The modern herbarium: not an oxymoron!

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The herbarium is often considered a relic of the past glory of descriptive taxonomy and obsolete in comparison with today's methodologies and high-tech facilities. The traditional uses of the herbarium include taxonomic research, plant identification, documentation and botanical teaching. Additionally, herbarium-derived materials are utilized in analyses in anatomy and ultrastructure, biochemistry, molecular systematics and other "modern" fields. The balance between specimen use in destructive sampling and preserving the plant material highlights the need for explicit policies regarding specimen use. Collection growth, pest management and associated health risks, and past use of nonarchival supplies and techniques provide examples of other physical challenges in herbarium management. Outdated collection arrangement and changes in plant names present problems in accessing the desired materials and data. A lack of understanding of the roles of herbaria frequently leads to a lack of support and sufficient funding. Yet an active, growing herbarium remains a uniquely important resource for deposition of voucher specimens, for biodiversity information, preparation of modern monographic works and Floras, introducing students to locally or seasonally unavailable plant groups, and for maintaining the storehouse of information for the future.

29. Truffles and false truffles in central Iowa: an update

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Fungi that produce their fruiting bodies underground tend to be overlooked. *Tuber gardneri* and *Elaphomyces variegatus* were reported from Iowa prior to 1940. Forays in central Iowa during the summers of 1980 and 1981 resulted in the following records for Iowa: *Tuber lyonii*, *Hydnobolites cerebriformis* and *Pachyphloeus*. To continue an investigation into the extent and variety of fungi that produce hypogeous fruiting bodies in central Iowa, further searches were conducted during the summers of 1995 and 1996. Ascomycetous species (truffles) collected included *Tuber lyonii*, *T. sp.*, *Pachyphloeus citrinus*, *Hydnobolites cerebriformis*, *Elaphomyces variegatus* and *E. anthracinus*. A Basidiomycetous species (false truffle) collected was *Hymenogaster*. Many

Ascomycetous hypogeous fungi are known to be ectomycorrhizal. Most truffles and false truffles are dependent on animal mycophagy for spore dispersal. Although a variety of studies have been published concerning the importance of these fungi in the ecosystems of the northwest United States, their significance in Iowa ecosystems is unknown.

30. Tendril development in *Antigonon leptopus* Hook. & Arn. (Polygonaceae)

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Tendrils are cylindrical coiling organs that are used as a climbing and support mechanism by a number of vines. The morphological origin of tendrils may be leaves, shoots, or inflorescence rachises, and varies with the species. Thus tendrils are a good example of convergent evolution. Coral vine (*Antigonon leptopus*), a native of Mexico and Central America, possesses tendrils which terminate axillary inflorescences. Typically, bract-subtended flowers develop on the basal portion of the inflorescence. A transition zone consisting of one or two nodes with tendril-subtended flowers occurs in the middle portion of the inflorescence, and the inflorescence terminates in three tendrils. Tendrils are initiated in the same manner as a leaf or bract, but they remain cylindrical except for what appears to be a rudimentary blade at the tip. Thus the tendril is most likely a leaf homologue. The initial coiling response takes place in the tendrils, but coiling also occurs in the inflorescence rachis, which becomes sclerified, and forms the permanent support structure for the vine. Thus, this species uses both stem and leaf homologues for support. This is the first report of tendril development for the family Polygonaceae.

31. Morphological and anatomical traits of Iowa's hard maples

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A two-year study was conducted to examine leaf morphology and anatomy of hard maples (*Acer saccharum* Marsh. and *Acer nigrum* Michx. f.) indigenous near the 43°N latitude from the 94°W longitude in Iowa to the 71°W longitude in Maine. Leaf samples were collected from multiple trees at each of 24 locations in 1995, and at 36 locations in 1996. For samples collected in 1995, stomate frequency and size showed a quadratic relationship with longitude and were greatest for leaves from western locations. Total

leaf thickness varied from 73 μm to 212 μm and did not relate to longitude. Thickness of the leaf epidermis and the palisade and spongy mesophyll layers also did not relate to longitude. Palisade thickness was three and a half times that of the mesophyll. Analysis of leaves collected over both years showed that trichome frequency, lamina area, and the percentage of lamina area partitioned in the basipetal lobes were related quadratically to longitude. These studies are being coordinated with research on drought effects on seedlings from selected populations to assess population differences in mechanisms governing plant water status.

32. A second species of *Paleomyrtinae* (Myrtaceae) from the North Dakota Paleocene?

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Paleomyrtinae is the genus name assigned to a fleshy fruit 1.6 by 0.78 cm that includes numerous small (1.8 mm long) seeds with curved embryos, first described by Pigg and Stockey from sites in British Columbia and North Dakota. We have begun a study of similar seeds found in the same layers at the North Dakota site to see if they might be a second species of *Paleomyrtinae*. They are similar in size, but somewhat larger (about 3.5 mm long) than *Paleomyrtinae*, and also have a curved embryo. Seed coat morphology is identical in the two species. However, there are obvious differences in seed structure. The new species has a concave side; *Paleomyrtinae* seeds are rounded. One end of the embryo sac is swollen and a large vascular mass extends from it into the seed coat. The other end is covered by a flared cap (about 0.5 mm long), both lacking in *Paleomyrtinae*. It also lacks certain obvious cell layers such as the "valve layer" of *Paleomyrtinae* and distinct layers of cells with obvious cell orientation around the embryo. We think this seed is not the same species of *Paleomyrtinae* described by Pigg and Stockey. Without well preserved fruit, we cannot even be sure it belongs in the Myrtaceae.

33. Comparing anatomy of extant *Ginkgo biloba* and North Dakota Paleocene *Ginkgo adiantoides*

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We collected well preserved seeds and leaves of *Ginkgo adiantoides* from the Sentinel Butte Formation (Paleocene) of central North Dakota. Seeds are three-dimensionally preserved including the outer fleshy seed

coat. Leaf petioles and laminae are also three-dimensionally preserved including adaxial and abaxial epidermis, stomates, cuticle, mesophyll, and vascular bundles with intact tracheary elements. We are in the process of comparing these fossils with light microscopy and scanning electron microscopy to extant *G. biloba* seeds and leaves. Our preliminary study indicates few differences between the fossil and extant species.

34. Leaf anatomy of *Parataxodium*, of the North Dakota Paleocene, Sentinel Butte formation

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Stem segments with flattened gymnosperm-like needles ranging in length from 30 mm to 430 mm have been assigned to the genus *Parataxodium* by Manchester et. al.. Our first impression of gross structure was that the stems with the longer leaves looked like extant *Metasequoia*, so we began a comparative study of the fossils and *Metasequoia* using SEM and light microscopy. Initial results indicated that they are not identical. The fossil leaves have a distinct midvein, but also have four smaller parallel veins, two on each side of the midvein. Additionally, we find regularly spaced glandular structures unlike anything reported in extant gymnosperm leaves. The fossils have regularly spaced intercellular spaces in the mesophyll unlike the alternating sheets of mesophyll and intercellular spaces found in many gymnosperms, including *Metasequoia*. We begin to question whether some of the fossils leaves are even gymnosperm.

35. Subepidermal idioblasts in leaves of *Scrophularia* and *Verbascum*: first verified report from Scrophulariaceae

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Internal secretory structures and idioblastic cells have rarely been reported from the large dicot family Scrophulariaceae, and foliar idioblasts only once, in 1887. We present the first unambiguous descriptions of foliar idioblasts, from *Scrophularia* (150 sp.) and *Verbascum* (350 sp.), two genera regarded by many as closely related based on non-anatomical evidence. Leaf pieces from 183 mostly herbarium specimens, representing 128 species with 51 replicates, were cleared (cell contents chemically dissolved) and their cell walls stained. Subepidermal idioblasts occurred in 63 of 89 *Scrophularia* species, or 69.7%, and in 13 of 39 *Verbascum* species (33.3%). Fourteen species

showing the range of anatomical variation were chosen for more detailed study by resin sections and scanning electron microscopy. The conspicuous spherical to ovate idioblasts occurred below both epidermises, and in some species they penetrated to the vascular bundle level. Petals also have idioblasts. All idioblasts had a thin primary cell wall and, surprisingly, all appeared to be empty. The idioblast evidence supports a close affinity between these two genera. Idioblast function, if any, remains unknown.

36. Effect of pocket gopher mounds on the distribution and life history of an annual forb within a tallgrass prairie

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The spatial relationship between the distribution of *Medicago lupulina* L., an annual forb, and mounds created by the plains pocket gopher (*Geomys bursarius*) was examined across a 0.64 hectare plot on Anderson Prairie in Emmet County, Iowa. Life history variation for *M. lupulina*, when growing on and off mounds, was examined as a possible mechanism to explain any positive spatial relationship between the distribution of mounds and *M. lupulina*. *M. lupulina* distribution was determined by a survey for flowering individuals in July 1995; gopher mound locations were surveyed throughout the growing seasons in 1994, 1995, and 1996. *M. lupulina* life history traits when growing on and off mounds were determined from a paired-treatment seed planting experiment on gopher mounds and in nearby off-mound sites. A strong positive relationship between 1995 *M. lupulina* distribution and that of mounds produced in 1994 was found, while the relationship between *M. lupulina* and mound distribution over three years was positive but weaker. In the planting experiment, germination was significantly greater in the off-mound planting sites, but survivorship, plant height, plant biomass, and reproduction were all significantly greater on the mounds. The strong dependence of *M. lupulina* on mounds for growth and reproduction is a good explanation for the positive relationship between gopher mound and *M. lupulina* spatial distributions.

37. Effects of microclimate on the ecophysiology of prairie plant species in the Loess Hills

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Between 1990 and 1992, the effect of slope azimuth on microclimate variables was measured on two sites in the Loess Hills Wildlife Area in Monona

County. During 1992, the effect of slope azimuth on soil moisture and the photosynthetic rates of five prairie species was monitored during the growing season on the same two sites. The objective of the study was to determine if differences in photosynthetic rates of plants was associated with variation in microclimates, and if differences in photosynthetic rates were correlated with the abundance of a species in the community.

As predicted by calculated values of potential shortwave radiation, the daily total photosynthetic photon flux density was greater (by as much as 20%) on the peak and south aspects than on north aspects. These differences accounted for higher air temperatures on south and west aspects, and lower soil moisture on south, west, and northwest slopes. The timing and pattern of cloud cover were important in decreasing the differences in photon flux density among slopes. When soil moisture levels were relatively low, photosynthetic rates of *A. gerardii* and soil moisture were both significantly lower on a south slope than on an adjacent east slope. When soil moisture levels were relatively high, photosynthetic rates of *B. curtipendula* were significantly higher on a southwest slope than an adjacent northeast slope. Differences in photosynthetic rates of forbs were less significant and unrelated to soil moisture.

CELLULAR, MOLECULAR, & MICROBIOLOGY

38. Sequence determination and comparison of S gene related fragments of *Lycopersicon esculentum*

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Previous work has shown that the expression of gametophytic self-incompatibility involves a single gene, known as S, which encodes a glycoprotein. The RNase activity of the S-glycoprotein acts upon the rRNA of an incompatible pollen tube while it is contained within the cells of the style. This ultimately leads to the cessation of growth for the incompatible pollen tube, and therefore prevents fertilization.

Polymerase chain reaction (PCR) technology with degenerate primers to conserved regions of related S-glycoproteins were used to amplify the S gene region in *Lycopersicon esculentum*, the cultivated tomato. One fragment was identified as an S gene, but bands of other sizes were also present.

This study has focused on determining the sequence of these unidentified PCR products of the *L. esculentum* S gene amplification. Sequences were obtained using a modified dideoxy method utilizing a

PCR protocol followed by electrophoresis and visualization by silver staining. Obtained sequences were compared to published S gene sequences for *L. esculentum* and other species to detect any homology. At least one fragment has been shown to not share homology with the *L. esculentum* S gene.

39. Post-transcriptional regulation of Human Renin Messenger RNA in Calu-6 Cells

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The physiological importance of renin has been recognized for decades, but the molecular mechanisms regulating human renin expression remain unclear. Recently, we have identified a novel human derived cell line, Calu-6, which endogenously expresses human renin (hRen) mRNA. As in vivo, hRen expression is dramatically induced (100-fold after 24 hours) after stimulation of intracellular cAMP by forskolin. We show here that studies utilizing inhibitors of transcription (Actinomycin D) and translation (cycloheximide and puromycin) have demonstrated that this induction is both transcriptionally and translationally dependent. However, transfection analysis using hRen-promoter-luciferase constructs along with nuclear runoff assays revealed that transcriptional regulation alone is insufficient to explain the high induction of hRen mRNA in response to cAMP stimulation. We have determined that post-transcriptional regulation of hRen mRNA is necessary for the cAMP-mediated hRen mRNA induction. The transcriptional inhibitors Actinomycin D and DRB were used to determine the rate of decay of cAMP-induced vs. uninduced hRen mRNA. A clear increase in hRen mRNA half-life is seen in Calu-6 cells treated with forskolin. These data demonstrate that hRen mRNA in Calu-6 cells is post-transcriptionally regulated at the level of mRNA stability. We are currently performing experiments to assess the mechanism for this response.

40. The first successful culture of probable macrophages from reptiles

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Pigmented cells, long known from turtle livers, have recently been redescribed as melanomacrophages. In our attempt to culture these cells we serendipitously established a cell line of unpigmented macrophages from the liver of a snapping turtle (*Chelydra serpentina*, family Chelydridae). This

culture has survived at this writing for over five weeks. The cells are amoeboid in appearance and, in division, appear to form both colonies of individual cells and syncytia. One syncytial cell had at least 13 nuclei with one to three nucleoli each. A zone of clearing was observed to form around the syncytia suggesting that these cells possess a mechanism to remove cellular debris. The culture responded to mammalian growth factor with greatly increased mitotic activity and growth showing that the receptors for this hormone in this primitive turtle family may have regions homologous to those of mammals.

41. Extraction of DNA from blood and linkage studies on a family affected with Stickler syndrome

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Twenty-four blood samples were submitted by members of a family affected with the connective tissue disorder, Stickler syndrome, a hereditary disorder that is characterized by osteoarthritis; mild vitreoretinal degeneration, myopia, cataract, and retinal detachment; sensorineural hearing loss; and various craniofacial abnormalities. Usually a family exhibits either ocular problems of loss of hearing as a result of the disorder. The family involved in this study was unique because the affected members exhibited both ocular and hearing difficulties. The proband was a member of the fourth generation, but the four other affected members belonged to generations two, three, and four.

DNA was extracted from the blood samples submitted using a procedure involving PCR buffer, lysis buffer, proteinase K, red blood cell lysis, and white blood cell lysis. Filtration and extraction with phenol and chloroform were used to purify the blood. The extracted DNA was used to create stock solutions for the PCR reactions. The reactions were run with ten different primers and radioactive phosphorous. Six primers were used to study the collagen type II gene, and four primers were used to study the collagen type XI gene. The radioactive phosphorous was used to label the PCR product. Electrophoresis reactions were run with the radioactive PCR products using acrylamide gels. The gels were then transferred to Watt paper, fixed, dried, placed in autorads and exposed. The autorads were developed and the alleles of the family members were read. One of the reactions resulted in a non-paternity. The alleles were read for the remaining nine reactions and linkage was determined.

42. Modular elements increase transformation frequency

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Recombination of foreign and genomic DNA may be enhanced by elements involved in DNA replication. Such DNA sequences have been identified and termed modular origin elements. Six *Glycine max* L. (soybean) DNA sequences were isolated to contain various modular origin elements and include: major and minor DNA unwinding elements, scaffold attachment regions, ARS-like consensus sequences, pyrimidine tracts, and topoisomerase II binding site elements. Expression vectors containing selected soybean modular elements and bacterial genes coding for beta-glucuronidase and neomycin phosphotransferase were introduced by microprojectile bombardment into soybean leaves. Effects of the selected soybean DNA sequences on transformation frequencies were compared in soybean. One sequence, SIRE-1, was found to increase transformation frequency two-fold. Characterization of integration sites are in progress to determine whether the increase in the transformation frequency may be the effect from nuclear localization sequences, nuclear retention sequences, amplification elements, and/or an increased potential for homologous or illegitimate recombination activity.

43. Isolation, characterization and *in situ* hybridization studies of the abundantly transcribed potato (*Solanum tuberosum* 'Superior') homeobox cDNA *POTH1*

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Homeobox genes contain sequences coding for DNA-binding motifs. These sequences are highly conserved across both the animal and plant kingdoms. Members of this gene family code for transcription factors which are key regulators of developmental organization. In an attempt to further elucidate the developmental process of tuberization in the potato plant, a full-length homeobox cDNA has been isolated via sequence homology from an early tuberization stage cDNA library constructed from 4-day axillary bud tubers. This cDNA, *POTH1*, has been sequenced and characterized by Southern blotting, northern analysis, sequence comparison, and *in situ* hybridization. *POTH1* is shown to be a class I homeobox gene with 45% overall similarity to *Kr-1* of maize and 73% match in the

homeobox region. Messenger RNA accumulation studies indicate that *POTH1* mRNA, unlike most homeobox transcripts, is not limited to a particular organ or developmental stage. Instead, *POTH1* mRNA accumulates in rapidly growing cells of the potato plant: the apical meristems, the vascular cambium, the edges of young leaves, axillary buds, and root tips. *In situ* studies indicate accumulation of *POTH1* mRNA in the tunica and corpus layers of the apical dome of the shoot apex and the stolon apex. In the stolon, growth and proliferation of the parenchymal cells associated with the vascular cambium contribute to swelling during early stages of tuberization, and this tissue accumulates *POTH1* mRNA. It is possible that *POTH1* may be post-transcriptionally regulated in a particular organ or stage of growth, or that it is involved in a wider range of growth processes than most plant homeobox genes.

44. Molecular systematics of arbuscular mycorrhizal fungi of the Genus *Glomus* as determined by analysis of the DNA sequence of the nuclear ribosomal RNA gene cluster

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Arbuscular mycorrhizal (AM) fungi are soil microorganisms that form mutualistic associations with plants. Because of the difficulty in culture of these fungi without a host plant not much is known about their biology. The present taxonomic grouping of VAM fungi is based upon the morphological characteristics of the mycelium and spores. Unfortunately these characteristics are not easily identifiable and are easily misinterpreted, creating disagreement concerning identification and classification of these organisms. Twelve samples from INVAM have been tentatively identified as either *Glomus clarum* or *Glomus manihot* through morphological identification means. However, this identification is uncertain. The use of sequence information that can be obtained from the 5.8s ribosomal coding DNA and the two spacer or ITS regions surrounding it was used to settle the question of classification in this group of fungi. DNA was isolated from spores and amplified using PCR. The universal primers used for the PCR amplification were ITS1 (5'TCCGCAGGTTACCTACGGA) AND ITS4 (5'TCCTCCGCTTATTGATATGC). Amplified DNA was sent to Iowa State University labs for sequencing. Parsimony analysis of the sequences will be done using the program PAUP.

POSTERS

45. SV40 small-t inhibits chaperone activity required for protein renaturing following heat shock

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The simian virus 40 (sv40) small-t antigen cooperates with large-T antigen to induce cell cycle progression and transformation of infected cells. We have mapped two regions of small-t that are important for these activities. Amino acid residues 97-103 are required for binding and inactivation of protein phosphatase 2A. A second region contains a domain conserved domain (HPDKGG) found at residues 42-47, part of which is similar to a motif present on the bacterial chaperone protein dnaJ (HPDK). This dnaJ domain is conserved in several molecular chaperones that are important regulators of protein folding, and these proteins frequently bind directly to heat shock proteins such as hsc 70.

The purpose of this study was to test the ability of small-t to affect the activity of known heat shock proteins. We utilized a rabbit reticulocyte system to assess the renaturation of luciferase in the presence or absence of small-t. Luciferase protein in the reticulocyte lost 70% of its activity following after being heated to 42°C for twenty minutes but regained most of its activity following a twenty minute incubation at 25°C due to the activity of nascent heat shock proteins. In the presence of small-t antigen, however, denatured luciferase failed to regain its activity, suggesting that small-t may interfere with the function of the heat shock proteins present in the lysate.

In future studies we plan to analyze small-t mutants to define the region of small-t involved in the inhibition of the stress response and to evaluate the role of hsc interaction with known activities of small-t antigen.

46. Development of a polymerase chain amplification assay for non-oncogenic human papillomaviruses

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Human papillomaviruses (HPV) infect mucocutaneous surfaces producing both benign and malignant proliferative lesions. Over 80 types of these viruses are known based upon homology studies of the viral genome. Whereas many of the known HPV geno-

types will cause cellular transformation, several HPV genotypes important to podiatric medicine, namely HPV types 1, 2, 4, 63 and 65, are associated with verruca plantaris and other benign lesions. These viruses have yet to be successfully propagated in cell culture, their replicative cycles studied, and there are few molecular or immunological assays to detect their presence in tissue obtained from patients. Furthermore, as successful treatment regimes may be related to the HPV genotype, sensitive and specific assays need to be developed. The objective of this study continues to be to develop and characterize one or more specific or multiplex polymerase chain reaction (PCR) assays for these HPV genotypes.

Specific-unique and consensus primers for HPV-1a and the other four genotypes were designed within the E2 gene. With one primer set consisting of an upper consensus and lower HPV-1a specific primer, the PCR reaction was optimized with regard to temperatures, cycle numbers, pH, and template concentration. The conditions permitted amplification and detection using ethidium bromide of approximately two copies of a 450 bp segment in the HPV-1a genome. Controls included HPV-2 and HPV-4 DNAs, human DNA, lambda and pBR322 DNAs and water.

47. Inhibitory mechanism of isotretinoin on neural crest cell migration

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Neural crest cells (NCC) contribute to a diverse array of vertebrate head and neck structures, and their proper migration is required. Retinoids are potent teratogens and exposure leads to an array of deformities in craniofacial, cardiac, and thymic structures. Abnormal differentiation and migration of NCC may cause these malformations. To further elucidate the drug's effect on cell migration, cranial and trunk neural fold explants were dissected from chick embryos and cultured with 13-cis-retinoic acid. Microphotography, image analysis, and immunostaining with an antibody to NCC were employed to quantitate cell behavior during drug exposure. Immunostaining demonstrated no difference between the NCC proportion of migratory cells in control and drug-treated groups at stages 9 and 10. A significantly higher proportion of NCC were identified from treated trunk neural folds explanted at stage 8. Microphotography revealed that 66-83% of treated NCC were rounded and 53-68% were clustered together compared to 23-28% rounded and 6-25% clustered for controls at stage 8, 9, and 10. Image analysis revealed that means for cell surface area, perimeter, and linearity index were lower for treated cells from stage 9 and 10 embryos, but not

for stage 8. Cell displacement means were lower for treated cells, reflecting a migration inhibition of 37% for stage 8, 27% for stage 9, and 80% for stage 10 explants. Inhibition of cell-substratum adhesion, spreading, and elongation may be mechanisms by which the drug acts in later stages (9 and 10) of development. But the results also suggest that at stage 8, before neural induction is complete, the drug may alter NCC to a trunk identity by anteroposterior transformation. Migratory paths would be altered and ultimately result in improper development.

CHEMICAL EDUCATION

48. Spark generated by the microwave heating of foods

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It has been observed that grapes, carrots, and many other fruits or vegetables when cut and placed next to one another and heated in a microwave oven, will spark with considerable size and duration. Further, we have found a correlation among the dielectric constant, sample size and shape, moisture content for different foods, and the amount of sparking that takes place in the microwave field. We have modeled this phenomenon with acetate sponges and salt solutions to mimic those present in a typical eukaryotic cell. We have found that a cut edge must be present, touching that of another cut edge, for the phenomenon to occur. This phenomenon seems similar to that of the "edge effect" where electrons congregate at the sharp edges and point of a metal in an electric field and can discharge via a spark to another edge or point nearby.

49. Iowa Chemistry Education Alliance: an innovative ICN program

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The Iowa Chemistry Education Alliance is an innovative supplemental chemistry education program that uses a high technology system. The ICN classrooms are a very integral part of the supplemental chemistry curriculum. Besides the ICN classroom activities, additional interactions are done using CU-CMe, FAX, telephone, and the internet (e-mail).

The presenters will share with the session

participants how the following needs were addressed with the innovative ICEA Program: a need for the learning of chemistry in a collaborative environment; a need for collaboration among chemistry teachers, chemists, and students of chemistry from a variety of educational settings; a need for increased use of technology for learning about chemistry that uses distance education approaches involving the ICN; a need for increased access to resources and modern chemistry instrumentation for teaching and learning about chemistry.

The ICEA project has addressed these concerns by developing a model chemistry curriculum using instructional modules that are technology-based and usable in a distance learning environment.

ICEA staff has developed materials and processes that encourage high school chemistry teachers to collaborate with other chemistry teachers as part of a concept-oriented, problem-solving supplemental chemistry curriculum.

POSTERS

50. Structure-stability relationships for alkali and alkaline earth metal complexes of 18-crown-6

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Molecular modeling provides an effective means to visualize the size dependence of metal-ligand interactions and to study the energy changes a ligand must undergo to accommodate a metal ion.

The structures of nine alkali and alkaline earth complexes of 18-crown-6 were modeled by the instructor using HyperChem software (Release 4.0). Missing parameters were added to the data set and the global minimum energy structures were stored prior to student use. The details of the MM+ calculation and the terminology of global versus local minimization was introduced prior to this exercise. In a pre-lab assignment students searched the literature for ion radii and stability constants for each of the complexes. Students visualized each complex and described what they saw qualitatively. An Excel macro was then run to extract the total and component energies of a single point MM+ calculation. Graphs were prepared to illustrate the relationship between the ionic radii, the stability constants and the total energies. Each of the component energies was examined to determine how the crown ether adjusted to the presence of the ion, i.e. by stretching, bending, twisting.

This exercise was developed for a sophomore level inorganic chemistry course as part of a NSF-CCD curriculum development project (DUE: 9354515) to integrate modeling techniques across the undergraduate chemistry curriculum.

CHEMISTRY: INORGANIC, PHYSICAL, & ANALYTICAL

51. Modeling the Dehydrochlorination of PVC using LD-FT-ICR MS

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With the advent of new polymer technology, many different types of plastics and plastic additives are being produced. These new types of additives and plastics make the recycling of polymers increasingly difficult. Pyrolysis is a recycling technique that allows for the thermal degradation of polymers and the retrieval of many different hydrocarbons. Pyrolysis is utilized to thermally degrade organic compounds and retrieve economically viable products from difficult to recycle starting materials. Since pyrolysis is based on thermal decomposition, the products that are produced are dependent on the amount of thermal energy that is allowed into the system. With the difficulty in knowing what hydrocarbons are going to be produced from the different types of plastics, a cost effective way to screen polymers rapidly needs to be developed.

Current techniques involve the use of pyrolysis-gas chromatography/mass spectrometry (py-GC/MS) and laser desorption time of flight mass spectrometry. These techniques allow analysis of the products but fail to give in-depth mechanistic details. Laser desorption Fourier transform ion cyclotron resonance mass spectrometry (LD-FT-ICR MS) allows for modeling of the chemistry associated with pyrolysis in a cost effective manner. This project provided a unique approach to changing the products formed, by optimizing the pyrolysis conditions (temperature and catalysts). Initial comparisons of data obtained using the LD-FT-ICR MS approach were compared to data obtained from thermal decomposition in a benchtop vacuum pyrolysis reactor. The good correlation indicated that the process can be modeled in the gas phase. One of the primary steps in the pyrolysis of poly(vinyl chloride) is the dehydrohalogenation reaction. The energetics of this reaction were studied both theoretically and empirically. Gas phase modeling in the presence of iron indicates that metals ions can act as a catalyst for the reaction.

52. RAIRS and TPD studies of the direct photopolymerization of thin films under ultrahigh vacuum conditions

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The photoinduced polymerization of cyclic monomers adsorbed on Ag(110) has been studied using a combination of reflectance absorption infrared spectroscopy (RAIRS) and temperature programmed desorption (TPD). The ultimate goal of this research is to form ordered thin polymeric films.

Styrene polymerizes upon ultraviolet irradiation. Post-irradiation TPD results indicate the formation of several species in the film, identified as dimer, trimer and tetramer. RAIRS data recorded as a function of temperature provide evidence for the formation of polystyrene. A mechanism for this reaction is proposed. Experiments are currently being performed using 1-vinyl-2-pyrrolidinone and aniline. The results of these studies will be presented and discussed.

53. Chemiluminescent flow injection measurement of glutamate in the presence of interference

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A flow injection chemiluminescent system has been developed for measuring micromolar concentrations of glutamate in synaptic vesicle samples, where the presence of glutamate is due to its role as a neurotransmitter. The analysis is achieved through the oxidative conversion of glutamate to hydrogen peroxide via glutamate oxidase. The signal is then generated by reaction of hydrogen peroxide with the chemiluminescent reagent lucigenin. The importance of this system is the ability to measure the concentration in the presence of interfering compounds such as ascorbic acid.

The system requires two parallel paths for the sample. The first path includes a glutamate oxidase reactor and the corresponding signal represents light produced from glutamate and endogenous interferences. A blank reactor is placed in the second path and the resulting signal corresponds to only the interferences. Subtraction of the two signals corresponds to a chemiluminescent intensity representative of only glutamate.

Calibration experiments illustrate a linear response to glutamate from 0-100 μ M with a detection limit of 1 μ M and a throughput of 80 samples per hour. A blind validation study demonstrates the ability to measure glutamate accurately in the absence of

interferences. Selectivity experiments have revealed the ability to measure glutamate accurately in the presence of interferences such as ascorbic acid.

54. Scanning probe microscopy of Langmuir-Blodgett films of potential organic unimolecular rectifiers

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Recent advances in scanning probe microscopy (SPM) have sparked an expansion of interest in rectification and its applications. One application of SPM is its use to study Langmuir-Blodgett (LB) films in order to determine their surface topography and to look for rectifying properties. LB films of cadmium arachidate, the "Cava" molecule (N-heptyl-benzothiazolium tricyanoquinodimethanide), and the "Ashwell molecule" (N-hexadecylquinolinium tricyanoquinodimethanide) have been shown to have rectifying properties. These properties can be quantified using the scanning tunneling spectroscopy (STS) mode on a clear STM image. An asymmetric current (I) - voltage (V) plot in the STS mode would indicate through-bond (TB) tunneling, instead of the usual quantum-mechanical symmetric through space (TS) tunneling. This would thereby show rectification which can be quantified.

LB films were examined in an attempt to determine their molecular structure and their rectifying properties. Atomic images of these LB films will be shown and results of their rectifying properties will be discussed. ***This work was supported by a NSF-REU grant.*

55. Atmospheric aspects of the chemistry of NO₂ and HNO₃ on metal oxide surfaces

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Over the past few years, concern regarding the effect of mankind on the atmosphere has greatly increased. Metal oxide particles are known to be released into the atmosphere through a variety of natural and anthropological means. While it is well known that metal oxides can have catalytic properties, the effect of the airborne oxide particles in heterogeneous atmospheric processes is not well understood. In this study, we have used mass spectrometry and FT-IR spectroscopy to investigate the chemistry of trace atmospheric gases (NO₂ and HNO₃) that affect the photochemical oxidant cycle with metal oxide particles. The role of relative humidity and solar light on the chemistry has also been investigated. Our

preliminary results suggest that heterogeneous chemistry is important in the troposphere and must be considered in global atmospheric models.

56. Analysis of polynuclear aromatic hydrocarbon contamination in Cedar Lake sediments

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Determination of polynuclear aromatic hydrocarbons (PAHs) in marine sediment is of interest because of their health hazards. PAHs come from a variety of sources such as the combustion of diesel fuel, gasoline, coal, and wood. In addition, PAHs have a very low water solubility and are quickly adsorbed by soils and particulates in the vicinity of the source. Cedar Lake is an industrial lake near the heart of the city of Cedar Rapids. It is surrounded by Interstate 380, commercial and residential buildings, active train tracks, and a coal fueled power plant. Thus, PAHs could potentially enter Cedar Lake sediments from a variety of sources.

Sediment samples were collected from various locations in Cedar Lake. Soxhlet extraction was then utilized to remove PAHs from the aqueous sediment. The concentrated extracts were analyzed by GC-MS using selected ion monitoring for quantification and full scans for identification. A total of twenty different PAHs were analyzed by GC-MS and quantified using deuterated internal standards. HPLC (with UV/visible and fluorescence detectors) was also utilized for analysis.

57. Computational study of the cyclizations of 6-hepten-2-one, 7-octen-2-one, 6-heptyn-2-one, and 5-phenyl-2-pentanone

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Swartz and co-workers have found that unsaturated ketones, such as 6-hepten-2-one, when electrochemically reduced by DMP⁺ give ketyl radical anions which cyclize into cyclic alcohols, with cis as the major product. Previous evidence has shown that cyclization undergoes a reversible mechanism that is dependent upon both thermodynamic and kinetic factors. *Ab initio* calculations can be used to better understand the reaction coordinate diagrams of such cyclizations. Molecules of interest are the starting materials, transition states and products of 6-hepten-2-one, 7-octen-2-one, 6-heptyn-2-one and 5-phenyl-2-pentanone. Free energies and enthalpies of activation

were calculated at the UHF/3-21G level of theory. MP4/6-31G* calculations for thermodynamic data is in progress. Zero point vibrational energies were also calculated for the molecules in question at the UHF/3-21G level of theory. It has been found that zero point energy corrections are negligible and therefore will not need to be calculated at the MP4/6-31 G* level.

58. Kinetic energy analysis of metastables using a two section electrostatic particle guide in a time-of-flight mass spectrometer

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The continued growth in biomolecular analysis has led to the need for efficient instrumentation. Most biomolecules are difficult to obtain and laborious to isolate, and this results in very small available sample sizes. The ability to obtain as much information from as little of sample is desired. To address this problem, work on a new technique in the area of time-of-flight mass spectrometry has been performed at the University of Northern Iowa. By the addition of a two section electrostatic particle guide, it has been shown that ion isolation and kinetic energy analysis can be accomplished in a single time-of-flight instrument. This advancement has allowed for tandem MS to be done in one time-of-flight mass spectrometer. By the use of this technique, structural information and ion isolation of trace samples can be obtained.

59. Ammonia and glutamate levels in hippocampal synaptic vesicles

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Increases in glutamate and ammonia levels in extracellular fluid surrounding toad eye cup and retinal tissue preparations have previously suggested that depolarization of these tissues results in simultaneous release of glutamate and ammonia. We hypothesized that the ammonia is stored within synaptic vesicles as a counterion for the neurotransmitter, glutamate, and that the two molecules are coreleased. Slices of rat hippocampus, which are known to contain high levels of glutamatergic neurons, were depolarized and release of glutamate and ammonia was observed. Additionally, synaptosomes were isolated from rat hippocampi, ruptured, and the synaptic vesicles collected. Glutamate and ammonia levels were determined in the synaptic vesicle containing buffers before and after the synaptic vesicles were dissolved with trichloroacetic acid. From

these analyses and the determination of vesicular protein concentrations, glutamate concentrations within the isolated synaptic vesicles were calculated to be 99.1 ± 36.3 mM (n=7) in HEPES buffer and 297 ± 77.6 mM (n=7) in ATP buffer. Intravesicular ammonia was not detected, however, upon rupturing of the synaptic vesicles. These experiments verify that glutamate is found within hippocampal synaptic vesicles at high concentrations. Moreover, these results demonstrate that no significant amount of ammonia is located within these same vesicles. The source of ammonia released into the extracellular fluid is yet to be determined.

60. Lifetime measurements using pre-dissociation imparted kinetic energy (PIKE) Analysis

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Fourier Transform Ion Cyclotron Resonance (FT-ICR) mass spectrometry has long been recognized for its flexibility for studying unimolecular and ion-molecule reactions. One of the inherent strengths of the technique is its ability to obtain information on the reaction kinetics and ion lifetimes that occur in the millisecond timescale. These studies are performed by direct observation of changes in the intensity of the reactants and products in the mass spectra. Often, reactions proceed through intermediates that dissociate prior to detection and therefore are not directly observed in the mass spectra. Although these are not compatible with direct ion detection, ion excitation can occur on the microsecond timescale and therefore can be used as a probe of short-lived intermediates.

The ability to study the translational kinetic energy of ions caused by rf ion excitation has been accomplished using the conductance limit orifice in a two-section cell as a kinetic energy filter. This same approach can be employed to measure the kinetic energy imparted to product ions following rf excitation of a short-lived intermediate precursor. If an intermediate is formed in the presence of a continuously applied rf excitation field that is resonant with its cyclotron frequency, it will gain translational energy at a rate given by the amplitude of the applied field, increasing the radius of its cyclotron orbit. Any product ions formed following dissociation will maintain their mass fraction of the kinetic energy and therefore maintain an increased cyclotron orbit. Because the rf excitation is mass specific, the product ions formed following dissociation of the intermediate will no longer gain kinetic energy, because the applied rf frequency will no longer be resonant with its cyclotron frequency. The amount of energy gained by the intermediate and imparted to any resulting product ions will be limited to the lifetime of the intermediate in the excitation field

prior to dissociation. Therefore, the translational kinetic energy of the product ion is directly related to the lifetime of the precursor intermediate. Successively increasing the amplitude of the applied rf excitation field will result in increased radii of the product ions. The radius of the product ion can then be monitored using the conductance limit orifice. Using this technique, the lifetimes of intermediates that cannot be directly observed in the FT-ICR mass spectrometer can be monitored.

Preliminary results monitoring the reactions of unimolecular and bimolecular reactions will be discussed.

61. Synthesis and characterization of ammoxidation model compounds

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The Sohio ammoxidation process, in which propylene, ammonia, and oxygen are converted to acrylonitrile and water, is used for the production of approximately nine billion pounds of acrylonitrile each year. The primary catalysts employed are mixtures of oxides of molybdenum and bismuth, molybdenum and tellurium, or uranium and antimony. In an attempt to better understand the role of the different metals, and to provide structural models for the catalysts, we have been synthesizing and characterizing homogeneous molybdenum-tellurium and tungsten-tellurium oxide compounds.

Our general approach has been to use tetrabutylammonium (TBA) salts to synthesize these materials in non-aqueous solvents to avoid unwanted side reactions of molybdenum and tungsten with water. The synthesis of two compounds, tentatively identified as $TBA_2Mo_2TeO_{11}H_2$ and $TBA_3PTeW_{11}O_{39}$, will be discussed. Their characterization by FTIR, FAB-MS, elemental analysis, and other methods will also be presented.

POSTERS

62. Room temperature phosphorescence of harmala alkaloids

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The harmala alkaloids are beta-carbolines which are used as shamanistic inebriants. Most of them are highly luminescent. We studied the room temperature phosphorescence of harmala alkaloids adsorbed on

filter paper. All of the alkaloids studied exhibited phosphorescence. The introduction of metal ions into the solid matrix affected the excitation and emission wavelengths and the intensity of phosphorescence emission. The phosphorescence characteristics did not correlate with that of the indoles, which are structurally related to the harmala alkaloids.

Correlations between the phosphorescence characteristics and values determined by CAChe molecular modeling system will be presented.

63. Binding of polycyclic aromatic hydrocarbons to humic acids

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Polycyclic aromatic hydrocarbons (PAH's) are industrial by-products of combustion but are also produced naturally by forest fires and volcanoes. PAH's are ubiquitous water pollutants. Humic acids are the natural breakdown products of organic matter. The binding of PAH's to humic acids is of interest because the bound PAH may have reduced toxicity; also, the humic acids may promote the transport of PAH's through aquatic systems.

Using a fluorescence quenching technique, we measured the binding of pyrene, phenanthrene, anthracene, and naphthalene, to Aldrich commercial humic acid and reference International Humic Substances Society peat and soil humic acids. Pyrene was found to have the strongest binding and naphthalene the weakest with anthracene and phenanthrene falling in between. A typical association constant for pyrene, bound to IHSS soil humic acid and normalized for organic content of the humic acid, was 1.0×10^5 ml/g.

Two models for PAH fluorescence quenching are considered and the quantum efficiency of the bound PAH-humic acid complex was found to be zero. PAH wall adsorption on the quartz fluorescence cell was also measured.

CHEMISTRY: ORGANIC & BIOLOGICAL

64. An enantioselective synthesis of Ω -methylsterigmatocystin and a formal synthesis of aflatoxin B1 and G1

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Ω -Methylsterigmatocystin, a biosynthetic precursor to the notorious aflatoxins, has been shown to be a

toxic and carcinogenic fungal metabolite. Progress has been made in elucidating the mechanism of interaction of the aflatoxins with DNA. However, relatively little is known about the interaction of the sterigmatocystin derivatives with cellular constituents. Understanding the mode of action of these mycotoxins continues to be a very active area of research. In this light, a synthesis of these compounds, particularly an enantioselective synthesis, could provide a useful means of obtaining structural analogs as a tool to investigate structure-activity relationships.

A synthesis of (-)- Ω -methylsterigmatocystin and a formal synthesis of (-)-aflatoxin B1 and G1 is presented in which the asymmetric induction is achieved through a chiral vinyl sulfoxide directed lactonization reaction. This key reaction involves treatment of a γ -substituted vinyl sulfoxide with dichloroketene, followed by dehalogenation. Using this procedure, γ -thio- γ -butyrolactones are produced in high yield and greater than 95% enantiomeric excess (ee). The resulting lactone is further manipulated to provide a 4-hydroxy-6-methoxy-3a,8a-dihydrofurobenzofuranone intermediate; the production of which constitutes a formal synthesis of the aflatoxins. Alternatively, this furobenzofuranone intermediate can be transformed, in a series of steps, to provide a sample of Ω -methylsterigmatocystin in excellent yield and 78% ee.

65. Effect of halide ions on alkene bromination

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Kinetics of the reaction between maleic acid and bromine have been investigated in aqueous solution at 25°C. In the presence of a large excess of alkene, good first-order kinetics are obtained for bromine loss, which is monitored spectrophotometrically at 390nm. The effect of halide ions on the reaction rate was examined at pH 1.8. Chloride markedly increases the rate of bromine uptake, while bromide slows the reaction. Br_3^- and Br_2Cl^- act as bromine donors under these conditions, with reactivities different from Br_2 . Likely products from the Br_2/Br^- system: bromohydrin and both meso and racemic dibromides are under investigation. Comparisons will be made between present results and previous work on aqueous bromination of alkenes.

66. Vacuum pyrolysis of automotive tires as a source of useful chemical feedstocks

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It should be quite obvious to everyone that there are a lot of used tires in the world. Using these tires as sources of fuels and construction materials are examples of ways to reuse this "resource." These uses must meet both the environmental and economic criteria to be a viable utilization option. We (and others) have been experimenting with the vacuum pyrolysis of tires to explore the possibility of producing useful chemical feedstocks for industry. Up to this point we have been able to isolate the monoterpene limonene in a 2% yield. This paper will discuss our methodologies and current research ongoing to improve the yields of terpenoid compounds.

67. Improving soybean oil performance as an industrial lubricant

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There are currently a number of ag-based industrial lubricants on the market. A major application is the use of ag based oils in various hydraulic systems. The major ag based oil is rapeseed (or its Canadian version canola), used in conjunction with various proprietary additive packages. Ongoing studies done by the UNI-ABIL Research Program and the UNI chemistry department have been involved in improving the lubricant characteristics and oxidative stability of soybean oil in order for it to be competitive with rapeseed oil. This presentation will discuss methods of evaluating and improving soybean oil's performance.

68. Biodegradation of explosives by wood-rotting fungi

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Several sites worldwide are contaminated with byproducts of the munitions industry. Bioremediation by fungi of soil, sediments and water contaminated by munitions waste is one method that is currently being

evaluated for decontamination of such sites. It is known that *Phanerochaete chrysosporium*, a wood rotting fungus, is able to degrade substantial amounts of 2,4,6-trinitrotoluene (TNT) to carbon dioxide, and this fungus shows some promise for use in remediation of contaminated sites. There are, however, many other species of wood rotting fungi and it is reasonable to expect that some may be as good or better than *P. chrysosporium* for this purpose. In the present study we have evaluated the biodegradative ability of F-600, a proprietary fungal strain developed by Mycotech Corporation. Our results demonstrate that F-600 mediates extensive biodegradation of TNT. Although very little TNT was degraded to carbon dioxide, mass balance analysis suggested that much of the TNT initially present was converted into biomass. Toxic metabolites, such as 2-amino-4,6-dinitrotoluene and 4-amino-2,6-dinitrotoluene did not accumulate and were present in only very small amounts. Evaluation of the ability of F-600 to enhance remediation of soil contaminated with munitions waste is currently under investigation at the Yorktown Naval Weapons Station (Yorktown, VA).

69. Synthesis and novel purification of a pentapeptide

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In general, a solid-phase peptide synthesis consists of the assembly of a protected peptide chain on a polymeric support and the subsequent cleavage/deprotection to release the crude, deprotected peptide from the solid support. Usually, these two steps are followed by chromatographic purification of the crude peptide. This paper describes the modified Fmoc solid phase peptide synthesis of a pentapeptide Leu-Gly-Pro-Phe-Ser, where each synthesis step was following by the addition of a capping agent, 3-nitrophthalic anhydride (NPA), to react with any failed peptide. The capping can be accomplished because the extended peptide possesses a blocked amino group at the N-terminus while the failed peptides possess a free N-terminus amino group. Once the failed peptide is capped, it is unavailable for further coupling steps. The result is a mixture of capped failed peptides of different lengths and the correctly extended peptide without a cap. Specific antibodies to this capping agent (NPA) were used to conjugate with and remove the antigenically capped, failed peptides from the reaction mixture. The peptide solutions were analyzed by Mass Spec and HPLC. All of the impurities detected were due to the synthesis and cleavage reagents with no failed peptides detected.

70. Synthesis of ring extended analogues of dideoxyadenosine as potential antiviral agents

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Natural dideoxyadenosine and its 2'-isomeric analogue possess significant antiviral activities. Search for more potent compounds within this class focused on modifications of the carbohydrate moiety. However, there are few examples that have studied hypermodification in the base moiety. In the search for new dideoxynucleosides with antiviral potential we have been exploring dideoxynucleosides with ring extended bases. In this paper the synthesis and antiviral studies of dideoxyadenosine analogues with ring extended bases will be described. Examples studied include compounds of both the normal and isomeric series. Detailed synthetic work, including preparation of hypermodified bases and structural data in support of the intermediates and target compounds, will be described. Synthesis of their phosphorylated derivatives will also be presented. Enzymology, including stability studies with hydrolytic enzymes, will be mentioned. Antiviral data will be discussed.

71. Synthesis of inhibitors to virulence in agrobacterium

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Agrobacterium is a unique soil organism which can transfer its plasmid DNA to plant cell when it has been exposed to a signal molecule and has become virulent. The use of this bacterium is the only known method for transforming plant cells other than a gun. Virulence is activated by phenolic signals secreted by wounded plant tissue. Inhibitors and inducers of virulence are useful in mapping out the binding site. Compounds based on a hydroxyfuranone structure have been synthesized to test inhibition of this process and to explore the nature and structure of the binding site for the phenolic signal compounds.

The synthesis of these compounds will be discussed and the assay developed to test inhibition will be presented. A proposed structure for the binding site and a proposed mechanism for the induction of virulence will be discussed.

72. Recovery of oil used for the agglomeration of coal by heating in a rotary evaporator

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Coal fines can be recovered and made free of mineral impurities by a process known as oil agglomeration. Various hydrocarbon streams have been used to agglomerate coal. Recovery of part of the oil used for agglomeration is necessary to make the process economical. If the oil is recovered by heating in a rotary evaporator, the quality of the agglomerates can be improved simultaneously with the recovery of oil.

In the present work, coal samples that had been agglomerated using number 2 and number 4 fuel oil were heated in a rotary evaporator at temperatures ranging from 220° to 850°F for lengths of time ranging up to several hours. Conditions leading to quantitative recovery of oil were elucidated. The amounts of oil and water recovered under less severe conditions were determined. The characteristics of the coal recovered under different protocols were compared. In addition, the characteristics of the recovered oils were compared with those of the virgin oil used to process the coal.

These tests indicated that compromise conditions must be chosen to minimize the energy inputs required for oil recovery while maximizing the amount of oil recovered and while producing the most desirable agglomerated coal. The recovered oil was found to be significantly lighter than the virgin material.

POSTERS

73. Synthesis of crystal violet: A submicroscale experiment for the organic chemistry laboratory

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During the past several years many undergraduate organic chemistry instructional laboratories have switched to a microscale approach. This approach has usually been adopted for economic and safety reasons. However, the ability to perform organic syntheses using very small quantities of starting materials is an important skill in its own right and we have developed a laboratory exercise to emphasize this skill. The triphenylmethane dye crystal violet is synthesized from Michler's ketone and N,N-dimethylaniline in the presence of phosphorus

oxychloride. Our modification of this well known procedure uses very small amounts of starting materials; smaller even than those that are used in most microscale organic syntheses found in published organic chemistry laboratory texts. Briefly, 0.5 mg of Michler's ketone, 1 μ l N,N-dimethylaniline and 0.5 μ l phosphorus oxychloride are heated at 115°C in a small sealed reaction vial for 15 min. The solution is then cooled and 2 μ l of water and 20 μ l methanol are added. The product is then purified by thin layer chromatography and characterized by UV visible spectroscopy. As an additional optional experiment, crystal violet containing wastes can be diluted with water and treated by titanium dioxide mediated photocatalysis. Several N-demethylation products were identified as intermediate products. This procedure resulted in extensive decolorization/degradation of crystal violet.

CONSERVATION

74. The conservation of Iowa's archaeological record: a vehicle for public education and participation

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Iowa's archaeological resources, both historic and prehistoric, are unique, non-renewable resources which present a record of at least 12,000 years of human activities. Although archaeological sites can be found in multiple environmental settings throughout all 99 Iowa counties they are not limitless and hence, are in need of the combined efforts of an interested public and an energetic profession. This paper discusses the present situation of archaeological conservation across the state, the need for greater public and professional cooperation, educational resources, and several currently available opportunities for direct participation in the on-going process of preserving and enhancing the record of our historic and prehistoric past.

75. Iowa's forest resources

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In 1981, Thomson and Hertel summarized the history of Iowa's forests. The General Land Office survey of 1832-1859 classed 6.68 million acres of Iowa land as forested. In 1974 the US Forest Service survey recorded 1.56 million forested acres, a loss of 64% of

the original forest. The most recent USFS survey (1990), reported forest cover at 1.9 million acres, a gain of 22% from 1974. This gain results from state and federal planting programs and, more significantly, a decline of the cattle industry in Iowa and reclassification of previously pastured woodlands. Iowa's oldest forests are about 150 years old, dating from timber harvest at the earliest period of Iowa's settlement. About 23% are more than 80 years old, 45% are between 40 and 80 years old, and 32% are less than 40 years old. The 1990 survey noted a significant increase (from 18 to 25%) in maple/basswood forests, reflecting: 1) a natural replacement of oaks by shade tolerant species, especially in eastern Iowa, and 2) selective harvesting of oaks. Whether to manage Iowa's upland forests for dominance by maple or by oak is complicated by lack of consensus on how to accomplish the latter. Another concern is the health of currently and recently pastured forests which are not regenerating either oak or maple as current canopy trees die or are harvested. 92% of Iowa's forests are privately owned. State and private organizations offer forest owners an array of programs designed to promote forest health and productivity for timber, wildlife, soil and water protection, and aesthetic values.

76. Preliminary natural history of the Eddyville Dunes and wetland complex

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The 1200 acre Eddyville Dunes complex of eolian sands and associated wetlands extends 4-5 miles along the east side of the Des Moines River valley near Eddyville, Iowa. The Dunes were mapped using the Chelsea and Sparta Loamy Fine Sand soils. Wetlands were mapped using Soil Surveys, field surveys, aerial photography, and USGS 7.5' topographic maps. Several of the wetlands exhibit diverse obligate wetland flora and are relatively undisturbed. Others exhibit less diversity and include abandoned fill sand quarries and farmed wetlands.

The flora and fauna of the Dunes have not been systematically studied. A preliminary flora lists 539 species including one state endangered (*Platanthera flava* var. *herbiola*) and five special concern species. Known fauna includes *Emydoidea blandingi* (Blanding's Turtle), *Cnemidophorus sexlineatus* (Six-lined Racerunner), and *Heterodon* sp. (Hognose Snake). A systematic study of the Eddyville Dunes would likely document additional flora and fauna. The proposed Eddyville Bypass mainline and north interchange access road would impact the southern half of the Dunes.

77. The effects of fire on leafhoppers and their relatives (Insecta: Homoptera: Auchenorrhyncha) from Cedar Hills Sand Prairie Preserve

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Isolated prairie preserves serve as a refuge for prairie-specialist organisms which require precise habitats and form intimate associations with specific prairie plants. It is essential that preserve managers develop and monitor management practices in order to maximize protection of prairie-restricted biota. As sensitive indicators of habitat condition and environmental change, insects are well-suited for use in ecological monitoring. Leafhoppers and their relatives may represent the best choice for monitoring because they include many prairie-specialist species which are commonly found within small preserve situations. We are investigating the effects of prescribed fire management on leafhoppers and their relatives from the Cedar Hills Sand Prairie Preserve, Black Hawk County, Iowa. The objective of our study is to measure the effects of prescribed fire management impacts on leafhopper assemblages and their associated plant communities by monitoring each sequential stage of prescribed burning.

78. Decline of Iowa populations of Regal Fritillary (*Speyeria idalia*)

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Regal Fritillary butterfly, *Speyeria idalia* Drury (Lepidoptera: Nymphalidae, Argynniinae), populations were surveyed for population size using mark-recapture estimates in 1996 at 16 sites across Iowa, South Dakota, and Kansas. Individual insects were weighed to the nearest 10 mg, and abdominal, thoracic, and wing lengths as well as head capsule widths were measured to the nearest 0.1 mm. Violet densities and total biomass estimates were calculated for all sites, and these estimates of the insect's larval hostplant availability were correlated to the size of the insect. No insect body measurements were significantly different comparing populations outside versus those in Iowa, except that weights of Iowa *S. idalia* insects were significantly less in areas of low hostplant density and abundance. Iowa prairie areas had diminished insect sizes, low *S. idalia* and hostplant populations.

79. *Gentiana x curtissii*, a new state record gentian hybrid on Hawthorne Prairie, Mahaska County, Iowa

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Gentiana x curtissii J. S. Pringle, a hybrid of *G. alba* x *G. puberulenta* identified on Hawthorne Prairie in Mahaska County, is a new state gentian hybrid in Iowa. Hawthorne Prairie is part of the Lake Hawthorne Wildlife Management Unit owned by the Iowa Department of Natural Resources. Except for a few widely distributed individuals, the two major populations and several small populations of *G. curtissii* co-exist with or are near populations of both *G. alba* and *G. puberulenta* on Hawthorne Prairie. Close proximity between members of the two parent species on the site results in potential for the latest flowers on *G. alba* plants to cross with the earliest flowers on *G. puberulenta* plants. Crossing likely occurs among hybrid plants and between hybrid and parent species plants. Stem, leaf, and flower measurements of obvious hybrid individuals indicate that floral characteristics are intermediate between those of the two parent species, but with a tendency toward characteristics of *G. alba*. Flower colors range from powder blue to plum to pale violet to creamy white with violet tinges, and flowers are generally flared open. The initial observation of unusual flowers at Hawthorne Prairie by a volunteer prairie steward that ultimately resulted in identification of *G. x curtissii* populations by a professional biologist emphasizes the importance of interactions between amateurs and professionals.

80. RAPD analysis of genetic diversity in wind- and insect-pollinated species of prairie plants

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Preservation of the tallgrass prairie gene pool requires understanding factors that influence genetic variation. Population size, geographic range, life form, mating system, and seed dispersal have been reported to contribute to observable genetic variation in plants. In this study, genetic diversity was examined in prairie species with various pollen dispersal mechanisms by RAPD (random amplified polymorphic DNA) profiling. Target species (i.e., species selected for genetic analysis) from three different geographic regions were selected to contrast genetic diversity in wind- and insect-pollinated species. RAPD probes were screened

for informative markers. Six probes (Pharmacia Biotech) revealed DNA polymorphisms in each of the species. Genetic differences found between species, within species among populations, or within populations will be discussed.

81. RAPD analysis of genetic diversity in prairie plants with wind-, animal-, and gravity-dispersed seed

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Understanding factors that influence genetic variation is important in the preservation of the tallgrass prairie gene pool. Factors that have been reported to contribute to observable genetic variation in plants include population size, geographic range, life form, mating system, and seed dispersal. In this study, genetic diversity was examined in prairie species with various seed dispersal mechanisms by RAPD (random amplified polymorphic DNA) profiling. Ten target species (i.e., species selected for genetic analysis) from two different geographic regions were selected to contrast genetic diversity in species with wind-, animal-, and gravity-dispersed seed. RAPD probes were screened for informative markers. Six probes (Pharmacia Biotech) revealed DNA polymorphisms in each of the species. Genetic differences found between species, within species among populations, or within populations will be discussed.

82. Status of Eurasian watermilfoil, *Myriophyllum spicatum*, in Iowa

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Eurasian watermilfoil is currently found in nearly forty states and three Canadian provinces. It was first discovered in Iowa in Crystal Lake (Hancock County) in 1993. Since then it has been discovered in five additional lakes and throughout those portions of the Mississippi River bordering Iowa.

During the 1996 Iowa legislative session, legislation was passed addressing Eurasian watermilfoil. This legislation prohibits acts which would result in the spread of this exotic aquatic weed. It also provided funding for establishment of the Iowa Eurasian Watermilfoil Program.

Initial activities conducted as part of the Iowa Eurasian Watermilfoil Program included public awareness and education, boat access monitoring, and

aquatic vegetation monitoring. During the 1996 field season, 3206 boats were inspected. Three of these boats were found to have Eurasian watermilfoil fragments. Ninety-one lakes were surveyed. Snyder Bend Lake (Woodbury County) was found to be infested.

83. Anuran diversity and population trends in east central Iowa from 1993-1996

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Since 1993, I have conducted three frog and toad breeding chorus survey routes in east central Iowa (Clinton and Scott Counties) as part of the Iowa Department of Natural Resources' state-wide project, designed to monitor anuran populations and distributions. Each route was sampled three times during the amphibian breeding season (early, middle, and late). At each point, species were identified by call and assigned a relative abundance code ranging from 1 to 3. Among the three routes, species diversity was similar each year (7 to 10 species). The relative abundance of each species was analyzed, among the four years and between the three routes, to determine population trends. Of the ten total species that have been identified, six differed significantly between the years. These included the western chorus frog (*Pseudacris triseriata*), eastern gray treefrog (*Hyla versicolor*), Cope's gray treefrog (*Hyla chrysoscelis*), northern leopard frog (*Rana pipiens*), American toad (*Bufo americanus*), and the cricket frog (*Acris crepitans*). Most of these species seemed to be increasing more recently. Only three species differed significantly between the routes, with no obvious trend. These species included the eastern gray treefrog (*Hyla versicolor*), Cope's gray treefrog (*Hyla chrysoscelis*), and the green frog (*Rana clamitans*). Based on this data, anuran populations seem to be influenced more by year than by location, suggesting that these populations are impacted substantially by short-term environmental factors such as weather or floods.

84. Midwestern raptor population trends as determined by forty years of Christmas Bird Count data

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Long-term information concerning regional raptor population trends is minimal. The Quad City Audubon Society has conducted five Christmas Bird Counts

(CBC), which center on or near the Mississippi River in east central Iowa and northwest Illinois, since the mid 1950's. We decided to use this CBC data to examine changes in Midwestern raptor populations from a more local perspective. During our analysis, we combined the data into five-year increments. Seven species are characterized by populations which were stable until the mid 1970's to mid 1980's, after which they have increased. These species include the sharp-shinned hawk (*Accipiter striatus*), Cooper's hawk (*Accipiter cooperii*), red-tailed hawk (*Buteo jamaicensis*), American kestrel (*Falco sparverius*), bald eagle (*Haliaeetus leucocephalus*), barred owl (*Strix varia*), and the eastern screech-owl (*Otus asio*). The red-shouldered hawk (*Buteo lineatus*), long-eared owl (*Asio otus*), and short-eared owl (*Asio flammeus*) are characterized by populations that have declined severely and have never recovered. Populations of the northern harrier (*Circus cyaneus*) and rough-legged hawk (*Buteo lagopus*) have fluctuated since the mid 1950's, while the great horned owl (*Bubo virginianus*) has steadily increased. We believe the CBC program can be used to monitor regional raptor population trends over time.

85. Using Christmas Bird Count data to monitor populations of icterids and species associated with humans

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Since the mid 1950's, the Quad City Audubon Society has conducted five Christmas Bird Counts (CBC) each year, centering on or near the Mississippi River in eastcentral Iowa and northwest Illinois. We used this long-term data to examine the population trends of several avian species closely associated with humans, as well as various icterid (blackbird) species. During our analysis, we combined the data into five-year increments. The population trends of the European starling (*Sturnus vulgaris*), house sparrow (*Passer domesticus*), red-winged blackbird (*Agelaius phoeniceus*), and brown-headed cowbird (*Molothrus ater*) have been characterized by large fluctuations. In contrast, the common grackle (*Quiscalus quiscula*) appeared to maintain a fairly stable population, interrupted by a brief increase. The American crow (*Corvus brachyrhynchos*) has steadily increased since the mid 1950's, while the meadowlark species (*Sturnella* sp.) have experienced a substantial decline since the late 1970's. Rock doves (*Columba livia*), which were not counted on CBC's prior to the mid 1970's, increased gradually through the 1980's and have since stabilized. The house finch (*Carpodacus mexicanus*), which was not present in the midwest until

the mid 1980's, continues to increase rapidly. We believe the CBC program can assist in monitoring avian population trends and responses to broad-scale as well as local environmental conditions.

86. Assessment of human activity impacts on bald eagle reproductive success along the Upper Mississippi River

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During 1994 and 1995, we assessed the effects of human activity on bald eagle (*Haliaeetus leucocephalus*) reproductive success within pools 9-11 of the Upper Mississippi River. We monitored 10 and 12 active nests during two-hour observation periods each week and every other weekend in 1994 and 1995, respectively. All human activity units (HAU) within 1.0 mile of the nest were recorded. Eagle productivity was compared between low and high traffic sites. In 1994, total HAU ranged from 9-125 at low traffic nests, resulting in an average of 2.16 HAU per hour. These sites produced 10 fledglings. By comparison, total HAU at high traffic nests ranged from 143-364 and averaged 7.68 HAU per hour. These sites fledged only 5 birds. In contrast, the 1995 total HAU at low traffic nests ranged from 24-111 and averaged 1.50 HAU per hour. However, these sites only fledged 6 birds. The total HAU at high traffic nests ranged from 130-260, resulting in an average of 3.88 HAU per hour. These sites produced 11 fledglings. The contradicting results between the two years may have been due to the much stronger dichotomy which distinguished high from low traffic sites in 1994, as compared to 1995. Essentially, all sites were relatively low traffic in 1995. Based on these results, higher rates of human activity did seem to negatively impact bald eagle productivity.

87. Avian monitoring and spring migration response to the 1993 flood on Mark Twain National Wildlife Refuge

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We have conducted avian point count surveys to monitor species composition and relative abundance for several years at the Big Timber and Keithsburg Divisions of the Wapello District of the Mark Twain National Wildlife Refuge. These surveys were conducted during spring and fall migration, as well as

during the breeding season. In three years (1992-1994) we have identified 113 species at Big Timber, including 53 species of Neotropical Migrants (NTM). After two years at Keithsburg (1993-1994), we had observed 124 species including 48 NTM. The record flood of 1993 provided an opportunity to examine the immediate response of the avian community to a major flood event. Initially, we have only analyzed spring migration data from Big Timber during the pre-flood (1992), flood (1993), and post-flood (1994) years. Preliminary results have indicated that a slightly greater number of individuals were observed following the flood, while species diversity declined. Additionally, habitat generalists and edge species seemed to increase, while habitat specialists and interior species were either maintaining stable populations or were decreasing. Although not statistically significant, we suggest these differences may be biologically important. Our results are limited and preliminary. Nevertheless, they suggest a possibly substantial and dynamic response by the avian community to major flooding events.

88. Occurrence of selected organochlorine compounds in fish tissue from eastern Iowa streams

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Organochlorine compounds were determined in whole common carp (*Cyprinus carpio*) and white suckers (*Catostomus commersoni*) collected at 16 sites in eastern Iowa in September 1995. This study, a part of the US Geological Survey's National Water-Quality Assessment (NAWQA) Program, was designed to investigate the effect of land use on organochlorine contaminants in fish tissue. Concentrations of dieldrin in fish tissue were larger in agricultural than urban settings. However, tissue concentrations of total chlordane, heptachlor epoxide, total DDT, and PCBs appeared to be related to both urban-residential and agricultural influences. Although use of DDT was banned nationally in 1972, three detections of the parent compound p,p'-DDT were found in fish from small urban and agricultural streams. Larger total concentrations of PCBs in fish tissue were found at sites in the Cedar River basin than in the Wapsipicon, Iowa, and Skunk River basins. Fish tissue from the Cedar River site near Conesville contained the greatest total concentration of organochlorine compounds of all sites in the study. With the exception of p,p'-DDT, organochlorine concentrations in fish tissue appeared to be independent of stream size, although in large rivers tissue concentrations generally increased from upstream to downstream. Total organochlorine concentrations exceeded national averages from

previous NAWQA studies, which encompassed a variety of land uses. This suggests that historical uses of organochlorine insecticides may have been greater in the Corn Belt than in other regions of the US.

89. Perspectives on Iowa's declining flora and fauna, 1997: Iowa's waters and fishes

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The conditions of Iowa's waters and fishes near the close of the 20th century reflect both considerable degradation and resiliency compared to pre-settlement conditions. Recent water quality data from Iowa's rivers show few violations of state criteria designed to protect aquatic life and show no serious negative trends that would affect Iowa's aquatic biota. The rise of confined animal feeding operations, however, presents a new threat to Iowa's water quality. Impacts to the physical characteristics of Iowa's waters are extensive and include channel straightening, delivery of excessive loads of silt to stream channels and lake basins, removal of riparian vegetation, and overpasturing of riparian areas. Historical impacts to the chemical and physical quality of Iowa's aquatic environments are reflected in changed distributions of fishes. Recent (post-1980) surveys show that most species described in 1981 as endangered or extirpated remain so in 1997. Several endangered species have not been collected in the state for over 40 years and should probably be considered extirpated. Several species described as endangered in 1981, however, have wider distributions than previously believed and do not appear to be in danger of extirpation. One species (freckled madtom, *Noturus nocturnus*) has been added to the state list of species since 1981. Despite considerable work on the distribution of Iowa fishes since 1981, the distribution and status of several species, especially those of large rivers, remain undetermined.

90. A series of stewards - how man marked the land of Walnut Creek

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The purpose of this study was the development of a land use history for prioritized sections (roughly 2500 acres) in the heart of the US Fish & Wildlife Service's Walnut Creek National Wildlife Refuge located south of Prairie City, Iowa. This history was researched to serve as a restoration reference for Refuge staff when

developing management strategies for the reintroduction of prairie and savannah ecosystems. The research will also be used to create educational programs, curricula, and interpretation for the public. Lastly, it will allow me to test my hypothesis that the study area is best suited to the Refuge's restoration efforts and not its former use as farmland.

Research consisted of visits to local government agricultural and private land record agencies, public libraries, and personal interviews with former and current area residents over a four-month period from May to August 1996. The study area was found to have been converted almost entirely to farmland soon after settlement, leaving scattered patches of original prairie and savannah ecosystems. By the 1920s and 30s, these remnants had all but disappeared. Topography confined the area to small fields while poor soils caused extensive use of various conservation reserve programs, tiling measures, and below average crop yields. In the late 1970s, much of the land was purchased with the intent of constructing a nuclear power plant there. The plant never reached fruition, and the area remained farmland until the Refuge's conception in 1992 . . . and the prairie's subsequent rebirth. This information, along with explicit interviewee comments, supports the current Walnut Creek restoration project.

91. Walnut Creek watershed restoration and water quality monitoring project, Jasper County, Iowa

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The Walnut Creek Watershed Restoration and Water Quality Monitoring Project began in April 1995 as a nonpoint-source monitoring program (NPS) in conjunction with the watershed habitat restoration and agricultural management changes being implemented by the US Fish & Wildlife Service (USFWS) at Walnut Creek National Wildlife Refuge and Prairie Learning Center (WNT). The WNT watershed is being restored to native prairie and/or savanna; riparian zones and wetlands will be restored in context. Walnut Creek is affected by many agricultural NPS water pollutants, including sediment, nutrients, pesticides, and animal waste.

A paired watershed approach is being used. Walnut and Squaw creeks are warm-water streams located in Jasper County, Iowa. Walnut Creek (study watershed) drains 12,860 acres, while Squaw Creek (control watershed) drains 11,710 acres. There are five components to the project: 1) tracking of land cover and land management changes within the basins; 2) stream gaging for discharge and suspended sediment at two locations on Walnut Creek and one on Squaw Creek; 3)

monthly to weekly surface water quality monitoring of Walnut and Squaw Creeks; 4) biomonitoring for fish and aquatic macroinvertebrates in Walnut and Squaw Creeks; and 5) groundwater quality and hydrologic monitoring.

Water quality results to date show very few differences between the creeks. Pesticide concentrations and frequency of detections are similar. Nitrate concentrations in both streams decline downstream possibly caused by biodegradation. The decline in Walnut Creek is slightly greater and may be reflecting the decrease in applied N in the basin as a result of the land use changes.

92. Water quality improvements in Sny Magill watershed

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The Sny Magill watershed project is an inter-agency effort designed to monitor and assess improvements in water quality resulting from the voluntary adoption of Best Management Practices (BMPs) by landowners within a 22,780 acre agricultural watershed. The BMPs are designed to reduce sediment, nutrient and pesticide delivery to the Sny Magill, a Coldwater trout stream located in Clayton County, Iowa.

Traditional erosion reducing BMPs such as terraces, water and sediment control basins, conservation tillage, contouring and stripcropping, have been adopted by landowners on over 80% of the watershed's cropland. Landowners are also encouraged to participate in an education-based program designed to reduce the over-application of nutrients and pesticides while maintaining productivity and profitability.

An increasing number of innovative BMPs are being applied for streambank stabilization, with many utilizing soil bioengineering, or "organic" based technologies. Installations based on willow plantings as well as warm season "prairie" grasses have been demonstrated.

The Sny Magill watershed project is also part of the US Environmental Protection Agency's Section 319 National Nonpoint Source Monitoring Program. In time, this study should help ascertain the appropriateness of various BMPs and quantitatively determine their impact on water quality in larger watersheds.

93. Sny Magill nonpoint source pollution monitoring project (Clayton County, Iowa)

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The Sny Magill Project, begun in 1991, is designed to monitor and assess improvements in the water quality of Sny Magill Creek that occur as a result of sediment, nutrient, and pesticide controls implemented in the Sny Magill watershed. A paired watershed approach is being used. Sediment, benthic macroinvertebrate, habitat, fish, and other physical and chemical data are collected from both Sny Magill Creek (study watershed) and Bloody Run Creek (control watershed) to evaluate trends in water-quality data. At this time, results from the monitoring are inconclusive. Sediment loads have increased for Sny Magill Creek relative to Bloody Run Creek. Analysis of the sediment data is complicated because so few days account for the majority of sediment discharged, and some intense rainstorms have affected Sny Magill and not Bloody Run. Similar benthic fauna occur in both streams. Some of the benthic data do show trends of improving water quality in Sny Magill Creek, while similar trends are not seen in Bloody Run Creek. The habitat assessment, conducted annually, provides a good characterization of habitat conditions, but may not be frequent enough to monitor year-to-year trends. The habitat variables do relate well to drainage area size and position in the landscape. The lack of metrics appropriate for northeast Iowa coldwater streams limits analysis of trends in the fish data. The frequency of pesticide detections has declined in Sny Magill Creek relative to Bloody Run Creek, however, nitrate concentrations have shown no decline in Sny Magill Creek.

94. Evaluating soil quality changes in a riparian buffer strip system using particulate organic matter

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Several authors suggest that the particulate organic matter (POM) fraction of soil is considered a good indicator of soil quality, and is more responsive than total soil organic matter to changes in management. This study evaluates POM in soils within different vegetation zones of a multi-species riparian buffer strip seven years after establishment. Improvements in soil quality are considered to be an indication of the potential of the buffer strip to serve as

an environmental buffer. Soil POM was assessed within two vegetation zones of a multi-species buffer strip (trees and switchgrass), two cropped fields (corn and soybeans), and within an abandoned pasture (cool season grass). All sampling sites are within the same soil mapping unit within the riparian zone of a perennial stream. POM was isolated by dispersing soil in 5 g L⁻¹ hexametaphosphate and passing the dispersed soil samples through a 53 micron sieve. Separated POM was finely ground and analyzed for total C using an automated C/N/S analyzer. POM within the tree zone was 286% greater and within the switchgrass was 119% greater than within cropped fields. Assuming that POM within the cropped field has changed relatively little over this same time period, these results suggest that the buffer strip vegetation is rapidly improving soil quality within the riparian zone.

95. Fine root dynamics, coarse root distribution and soil respiration rates in a multi-species riparian buffer system

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In 1990, a multi-species riparian buffer system was planted in previously row-cropped soil to intercept nonpoint source pollutants moving from a crop field to a stream. The system consists of five rows of trees planted nearest the stream, two rows of shrubs and a 7 m wide strip of switchgrass adjacent to the crop field. The hypothesis is that reestablishing permanent vegetation will improve soil quality by increasing organic matter. This study is being conducted to establish the timing of below-ground organic matter addition by the fine roots (<2 mm diameter) of poplar trees, switchgrass, abandoned pasture grass, corn and soybeans. The dynamics of fine roots were assessed by sequentially collecting 35 cm deep cores monthly from April through November. Coarse roots were described by excavating 1x1x2 m pits and sieving all roots excavated in 40 cm depth increments. Soil respiration is being measured monthly using a soda-lime technique. Fine root biomass for the pasture grass, poplar trees, and switchgrass were over 7,500 kg ha⁻¹ while crop root biomass was below 1,000 kg ha⁻¹. Coarse roots of trees and switchgrass extended to more than 1 m in depth with switchgrass roots being more intensively distributed. Pasture grass and crop roots were concentrated in the upper 6 cm of soil. Soil respiration rates under the trees, switchgrass and pasture grasses were up to twice as high as those for cropped fields.

96. Effects of suspended solids on larval walleye: A laboratory study

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Agricultural runoff is a major factor affecting the water quality of Iowa's rivers and streams because 66.7% of the state's surface is planted in crops, mostly corn and soybeans, which renders the land highly susceptible to water erosion. US Geological Survey data for 1993 and 1994 indicate suspended sediment concentrations ranging from 3 to 3,180 mg/L in 1993 and 4 to 3,230 mg/L in 1994 in Iowa rivers and streams. Poor recruitment of walleye *Stizostedion vitreum* is considered the major reason for sparse walleye populations in Iowa rivers, although the cause is unknown, the premise of the experiment was that recruitment may be affected by sediment or suspended solids. We conducted two experiments (E1 and E2) to determine the effects of suspended solids (SS) on survival, growth, and gill histology of prolarva to early juvenile walleye, which is a critical interval in establishing year-class strength. A commercial aluminum-silicate clay was used as the source of solids. Walleye were exposed to SS concentrations ranging from 2 to 360 mg/L, a lower range of the concentrations commonly recorded in inland streams of Iowa. Because there was a linear relationship between turbidity and the concentration of SS (clay), turbidity, expressed in nephelometric turbidity units (NTU), was used throughout the experiments as a measure of SS concentrations. In both experiments, survival-turbidity curves when fish were 28-d posthatch were parabolic: maximum survival was 46% at 164 NTU in E1, and 34% in E2 at 200 NTU. In both experiments, length-turbidity curves at 28-d posthatch were also parabolic. The maximum total length was 22 mm at 150 NTU in E1 and 27 mm at 200 NTU in E2. Gills of fish were examined for epithelial lifting, necrosis, lamellar fusion, hyperplasia, and clubbing. No histological alterations were observed. Although walleye are regarded as an "extremely sensitive fish" to suspended solids, these findings indicate that chronic exposure of larval and early juvenile walleye to SS at concentrations as high as 360 mg/L are not harmful.

POSTERS

97. The effect of potassium fertilization on the establishment of prairie species on sandy loam soils in east-central Iowa

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Prairie grasses and forbs were seeded into sandy loam soils at the Indian Creek Nature Center, Cedar Rapids, Iowa, in May and June, 1995. Potassium fertilizer was applied in strips alternating with unfertilized strips. In October, 1995, ten 10 x 50 cm plots were sampled for biomass by species in both fertilized and unfertilized strips. In addition fifty (10 x 50 cm) plots (fertilized) and ninety plots (unfertilized) were sampled for percent frequency of all species. Results showed no statistical differences in either biomass or percent frequency between weedy and prairie species ($P=0.05$) in the two treatments. Sampling for percent frequency of all species in October, 1996, of fifty plots in each treatment showed no statistical difference between fertilized and unfertilized strips ($P=0.05$).

98. Distribution and population density of *Speyeria idalia* in western Iowa

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The regal fritillary (*Speyeria idalia*), a common prairie butterfly species in Iowa, is disappearing from much of its range nationwide. Transect monitoring at 11 wet to dry, tall or mixed grass prairie remnants in Woodbury and Plymouth counties showed it abundant at 8 sites. The majority of the sites contained the larval foodplants (the prairie violet [*Viola petalifida*] and/or the Missouri violet [*Viola missouriensis*]) during early June. Population density calculations show haying to be the best management practice for the regal fritillary. But the future of the regal fritillary is in jeopardy because of habitat destruction, urban development, succession, and other factors.

99. Breeding season anuran monitoring and distribution at two Upper Mississippi River floodplain sites

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In 1995 the Wapello District of the Mark Twain National Wildlife Refuge initiated an anuran breeding chorus survey project at their Big Timber and Keithsburg Divisions, to determine frog and toad diversity, distribution, and relative abundance. We established a 5-point survey route within the interior and another along the edge of each division. Three surveys were conducted during the amphibian breeding season (early, middle, and late). Each species identified during the 10-minute sampling period was assigned a relative abundance code ranging from 1 to 3. Overall, 9 species of frogs and toads were identified (8 at each site). Of the 7 species common to both locations, 6 were more abundant at Keithsburg. At Big Timber, all 8 species were encountered in the interior, while only 5 were recorded at the edge. Of these 8 species, 6 were more abundant in the interior. In comparison, at Keithsburg all 8 species were identified at the edge and 7 occurred in the interior. Nevertheless, 5 of these were again more abundant in the interior. A comparison between the interiors of the two locations revealed similar diversities (8 and 7 species, respectively). However, most of these (5 species) were more abundant at Keithsburg. The edge at Keithsburg had greater diversity (8 species) than the edge at Big Timber (5 species). Again, most species (7) were more abundant at Keithsburg. Based on this data, it appears that breeding anurans prefer the wetland interiors and highly lentic areas of floodplain forests.

100. Water quality improvements in Sny Magill watershed

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The Sny Magill watershed project is an inter-agency effort designed to monitor and assess improvements in water quality resulting from the voluntary adoption of Best Management Practices (BMPs) by landowners within a 22,780 acre agricultural watershed. The BMPs are designed to reduce sediment, nutrient and pesticide delivery to the Sny Magill, a Coldwater trout stream located in Clayton County, Iowa.

Traditional erosion reducing BMPs such as terraces, water and sediment control basins, conservation tillage, contouring and strip cropping, have been adopted by landowners on over 80% of the watershed's cropland. Landowners are also encouraged to participate in an education-based program designed to reduce the over-application of nutrients and pesticides while maintaining productivity and profitability.

An increasing number of innovative BMPs are being applied for streambank stabilization, with many utilizing soil bioengineering, or "organic" based technologies. Installations based on willow plantings as well as warm season "prairie" grasses have been demonstrated.

The Sny Magill watershed project is also part of the US Environmental Protection Agency's Section 319 National Nonpoint Source Monitoring Program. In time, this study should help ascertain the appropriateness of various BMPs and quantitatively determine their impact on water quality in larger watersheds.

ENGINEERING

101. Two-phase flow modeling of suspended sediment transport

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The movement of sediment strongly affects the fate of absorbable contaminants (e.g. pesticides and herbicides). It is also important in reservoir operation and problems such as scour around bridge piers or deposition at channel diversions. Still, however, our ability to quantitatively predict sediment movement is inadequate. Most hydraulic modeling of suspended sediment transport employs two major assumptions: 1) the sediment does not affect the flow field; and 2) the sediment velocity is the same as the fluid velocity except for a constant fall velocity (which may be hindered due to presence of other particles). Recent experiments have shown these not to be true. Many researchers have shown that sediment can significantly affect the velocity and turbulence quantities of the fluid. In addition, the velocity of the sediment has been shown to be measurably different from that of the fluid (Muste, 1996). The problems with these assumptions become worse near the bed where sediment concentrations and velocity gradients are the largest.

A model is proposed that incorporates the coupling between sediment and water phases and makes no assumption about the velocity of the sediment. There are two mechanisms by which the sediment can affect the flow and vice versa. The water

exerts a drag force on the sediment and the sediment will affect the turbulence structure of the flow. The model is compared to recent experimental results that measured fluid and sediment velocities separately in an open channel flume using discriminating Laser Doppler Velocimetry (LDV).

102. Use of the Iowa Communications Network for undergraduate engineering programs

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The Iowa Communications Network (ICN) has given Iowa citizens a unique system, and has challenged educators to meet the needs of our citizens in new, effective, and economical ways. Surveys and studies by industrial leaders and the Chamber of Commerce in the Cedar Rapids-Marion area showed a substantial group of members of the technical work force in the community who, though placebound, are qualified and want to work toward completion of a baccalaureate degree in engineering.

A partnership involving industry in the area, Kirkwood Community College, Iowa State University, and the University of Iowa has made possible a program leading to a Bachelor of Science in Electrical Engineering to meet this need and desire. Delivery of engineering courses via the ICN began in summer, 1996. Studies of opportunities in other programs and other communities are underway.

The survey information, nature of the partnership, evaluation of prospective students, and a description of the program will be given. Some discussion of the challenges faced will be included. Opportunities for additional partnerships will be described.

103. Computer-aided Design of Engineering Experiments

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In most R&D settings engineering experimentation presents seemingly hopeless predicaments. The response variables of interest may or may not vary strongly with all the variables one has at hand for controlling those responses. Worse yet, the physical and chemical phenomena involved are often so complicated as to make it impossible to elucidate the theoretically correct mathematical formula for relating the responses to the control variables at hand.

Despite all this and more, there is a sound, straight-forward strategy for handling R&D projects of this sort and for successfully optimizing the responses

of interest, even though the true mathematical model may never be known.

A brief description and introduction to one of the most successful of these strategies will be presented.

GEOLOGY

104. Problems with computer modeling world sea level changes as a function of sea-floor spreading

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An attempt was made to model changes in sea level as a function of seafloor spreading. The model was based upon a simulation that used Lego® blocks developed as part of the C.E.E.P. module "Why Does the Sea Level Change?" The initial computer model employed one ocean basin whose area was proportional to the area of present oceanic basins. This basin was bordered on both edges by subduction zones, a continental slope, shelf, and raised land mass. A symmetric spreading center was located at the center of the ocean basin. Problems encountered were: 1) because the oceanic basin was so wide, realistic ages could not be assigned to segments of the initial oceanic crust; 2) a single ocean basin was so wide that the oceanic crust created was much older when subducted than any terrestrial oceanic crust; 3) the common formula, $D = Kt^{1/2}$, where D is depth of subsidence of the ocean floor, K is a constant, and t is age of the oceanic crust, produced ocean basins much deeper than current terrestrial ocean basins. This was especially true for older oceanic crust; 4) continents and/or trenches needed to rise or sink when subducted oceanic crust was deeper or shallower than previously subducted crust; 5) account must be made of both the rate of divergence and the rate of basalt production in calculating initial depths; and 6) when the whole ocean floor and continental mass were rising or falling together, circular arguments were produced regarding the calculation of sea level.

Continuing efforts are being made to refine and overcome problems associated with the model.

105. Earth shaking design: construction of a Lehman type seismograph for classroom use

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We have designed an inexpensive prototype seismograph that is easily assembled and installed into high school or college classrooms. The total cost of construction was \$166.89 for electronic and instrument components. Constructing a seismograph is not only fun but is also educational. The project teaches students electronics, mechanic, and computer programming while giving them an opportunity to study earthquakes and the geologic processes that cause them.

We also developed a World Wide Web homepage that contains seismograph design details, links to other seismology information, and access to earthquake records recorded at Morningside College. Earthquakes recorded on our seismograph are automatically loaded into our homepage.

106. Rates of hornblende etching and feldspar weathering in moraine soils; Wind River Range, Wyoming

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Hornblende grains in the soil matrix of moraines of the Wind River Range, Wyoming, etch at different rates which are dependent on the texture of the parent material and the soil moisture. Etching of hornblende decreases logarithmically with increasing depth within a profile, yet increases with the age of the deposit. Accelerated etching rates can also be found at higher elevations due to higher precipitations or the influence of long-term snow cover.

This study focuses on the use of etching rates and feldspar weathering as a basis for relative dating of moraines in the Wind River Range. The etching rates were used to make a relative age determination for each of the sampled moraines. The samples were taken from locations at varying depths from the south end of the Wind River Range. Results from the analysis of the soil samples indicate that the moraines correlate with several different glacial advances, dating from ~280,000 yr B.P. to ~7,000 yr B.P.

107. Petrography and Carbonate Geochemistry of cements of the Codell Sandstone Member, Carlile Formation, Middle Turonian, Eastern Margin of the Western Interior Seaway

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A cored section of the Codell Sandstone in Miner County, South Dakota, records deposition of eastern-sourced fluvial and marginal marine sand during middle Turonian regression. This coarsening upward interval contains both siderite and calcite cements. The cements consist of nonluminescent sideritic microspars (C1), luminescent poikilotopic calcite (C2), and speckled luminescent and nonluminescent inclusion-rich fibrous calcite (C3). C1 occurs in mudstone beds and as intergranular cement coating sand grains. C2 occurs as intergranular cement in the sandstone that filled remaining primary porosity. C3 filled septarian veins in the sandstone. Siderite and calcite coexist as early cements, providing an opportunity to evaluate paleohydrology and paleotemperatures using published ¹⁸O fractionation equations. $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ values of C1 and C3 were published by Ludvigson et al. (1994 GSA-SP 287) and were interpreted to record meteoric-marine fluid mixing. C1 ¹⁸O data have now been corrected after Carothers et al. (1988, GCA 52:2445-2450). Reevaluation of C1 and C3 by ¹⁸O fractionation equations shows that they did not precipitate from the same fluids, and C3 may have precipitated from warmer, burial-related fluids. Further isotopic analysis of C1 and C2 are under way to clarify early fluid evolution in the unit.

108. Outlier of Cretaceous Niobrara Formation in Lyon County, Iowa

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The presence of erosional outliers of sandy chalks of the Late Cretaceous Niobrara Formation in SW Lyon County, northwesternmost Iowa, has long been suspected. A buried bedrock upland in T98N, R48W has elevations that overlap with known Niobrara sections nearby in South Dakota, and a water well

(GSB W-11204) drilled into this bedrock upland penetrates units with similar lithologic compositions. SEM inspection of molluscan fragments recovered from the 220-230' depth interval in the well shows that the surfaces of these fossils are partly coated by adhering coccolithophores, the pelagic golden-brown algal forms of which Cretaceous chalks are composed. In particular, recognition of the zonally-significant early Campanian coccolith *Aspidolithus parvus*, known from the Smokey Hill Member of the Niobrara Formation, confirms that the bedrock units penetrated in W-11204 are part of the Niobrara Formation - the first known occurrence in the state of Iowa. These efforts were undertaken as part of a systematic re-appraisal of subsurface information in northwestern Iowa leading to production of a new bedrock geologic map of the state, supported by the National Cooperative Geologic Mapping Program through the US Geological Survey under Assistance Award No. 1434-HQ-96-AG-01486.

109. Sinkhole characteristics in Floyd County, Iowa

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Although northeast Iowa is completely mantled by variable thicknesses of pre-illinoian age glacial sediments and Wisconsinan loess, sinkholes commonly form where limestone bedrock is within 15 meters of the surface. In Floyd County, Iowa, Devonian limestone is near the surface and sinkholes dot the countryside.

In an effort to study the distribution and characteristics of sinkholes in this part of Iowa, measurements of sinkholes from 1:24,000 topographic maps were made in three research areas, Rudd, Floyd, and Nashua. Information was gathered on sinkhole distribution, width, length, depth, and depth to bedrock. The Floyd and Nashua research areas are dominated by the Lithograph City Formation and are abundant with sinkholes. In the Rudd research area, sinkholes are less abundant and larger compared with the Floyd and Nashua research areas. Depth to bedrock is greater compared with the Floyd and Nashua research areas. The Shell Rock Formation is the primary bedrock in the Rudd research area shows less fracturing.

Differences in sinkhole abundance and dimensions in the three research areas appear to be attributed to the bedrock. The greatest number of sinkholes occurs where bedrock of the Cedar Valley Group is at or within a few meters of the surface and the limestone is highly jointed. Few sinkholes occur in the less highly jointed limestone of the Shell Rock Formation.

110. Water quality approach to gypsum exploration around Fort Dodge

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Fort Dodge has been a major producer of gypsum for the United States over the past century. Available resources are quickly diminishing with an estimated 20 to 50 years of gypsum remaining. The anomalous, discontinuous nature of the Fort Dodge Formation, which includes the gypsum beds, makes exploration difficult and expensive. The search for additional deposits is currently underway through sampling rural water wells.

Untreated private well water should show elevated sulfate levels if soluble gypsum is present near the water source. Sulfate analyses are completed using the Hach Chemical DR/700 Colorimeter. Sulfate concentrations ranged from under 100 ppm to over 1000 ppm in wells around Fort Dodge. Highest sulfate levels were recorded near existing quarries with values decreasing with distance from the quarries. Elevated levels were also recorded near suspected gypsum deposits located through previous well drillings. With additional research this exploration may provide clearer evidence of subsurface gypsum deposits for industrial use.

111. A hydrologic and geochemical investigation of prairie pothole wetlands near the Southern terminus of the Des Moines Lobe, Iowa

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A hydrogeologic and geochemical investigation of the McIntyre wetland located near the southern terminus of the Des Moines Lobe (DML) was initiated to create a hydrologic and chemical budget. Central Iowa is the southernmost prairie pothole district in the United States. The geology, climate, soils, and resulting hydrology of the McIntyre wetland is significantly different from those where the majority of pothole wetland studies have been conducted. The DML advance resulted in the development of a complex series of linked depressions, which may function as relatively permeable, shallow subsurface drainage systems. The basin stratigraphy consists of Holocene-age muck overlying till-derived colluvium which buries peat lying over late Wisconsin glacio-fluvial sand. A total of 17 nested wells were installed in each major stratigraphic unit within the submergent and emergent zones of the wetland and its upland watershed. Transducers continuously recorded water levels in four

wells. The remaining wells were monitored weekly from April 1996 through May 1997. Analysis of water level measurements indicates a downward gradient in submergent zones and an upward gradient in emergent zones. Gradients near the SE side of the wetland indicate subsurface flow out of the wetland. Preliminary chemical analysis of the McIntyre wetland indicates that it is similar to surface and shallow ground water values for the DML. The dominant ions are calcium and bicarbonate. Conductivity, dissolved oxygen, and pH stay fairly constant through the growing season. The McIntyre and other DML wetlands typically exhibit lower total dissolved solids, relative to the more northerly and westerly parts of the Prairie Pothole region.

112. Hydrogeology and water quality within three constructed riparian buffer strips adjacent to Bear Creek in central Iowa

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Construction of "buffer strips" as replacement for natural riparian areas is under consideration as a method to improve soil and water quality in agricultural areas in Iowa. The purpose of this study is to understand groundwater flow to Bear Creek through three constructed riparian buffer strips: two 20-m-wide by 90-m-long strips at the Risdal site (Risdal North and South) and one strip of similar dimensions at the Strum site (Strum East). Strips contain rows of switchgrass, shrubs, and various tree species planted in 2 to 4 m of heterogeneous sandy and silty alluvium. The alluvium is underlain by approximately 1 m of diamicton (till) and shaley limestone bedrock. Each strip is instrumented with 48 lysimeters and tensiometers (nested), 12 water-table piezometers, and a stage recorder on the creek. Slug test results performed at the three sites show an overall geometric mean hydraulic conductivity (K) of 5×10^{-5} m/s (N=35), with lower values ($K=10^{-5}$ m/s) at Risdal and slightly higher values ($K=10^{-4}$ m/s) at Strum East. Groundwater flowed towards the creek during June to November 1996 under average hydraulic gradients of 0.02 (Risdal) and 0.001 (Strum). Estimated groundwater residence time in the strips is 2 months. $\text{NO}_3\text{-N}$ concentrations decrease along the flow path (from 24 mg/L at the field boundary to 0 mg/L at the creek) at Risdal North, but they are variable (0 to 18 mg/L) at Risdal South and consistently ~7 mg/L at Strum East. Water quality variations probably reflect differences in fertilizer applications, organic carbon sources for denitrification, upgradient site geology, and heterogeneity.

113. Use of environmental isotopes in storm runoff analysis of the Cedar River, north-east Iowa

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The environmental isotopes such as Oxygen-18 and Deuterium content of rainwater differ from that of the groundwater in most areas. This isotopic difference can be used to separate the 'rain' component from the 'prestorm' water in streams following storm events. Oxygen-18 and Deuterium isotopic data obtained from the Cedar River during a storm event on August 7, 1996, were used in a two-component mixing model to separate the stream discharge hydrograph in 'new' rainwater and 'old' pre-storm components. Both oxygen and Deuterium data indicate that over 80% of the discharged water in the stream was groundwater. The Overland flow component appeared in the stream approximately 7 hours after the storm event. During 100 hours of discharge recession, isotopic signature of discharge water did not approach the base flow value indicating an extended period of overland flow. The hydrograph indicates that majority of the rainwater infiltrated to the subsurface storage, and the stream was fed by the prestorm water from the subsurface. Results of chemical analyses for waters collected across the hydrograph show that major-ion concentrations were fairly constant during the storm showing only a minor decrease during peak discharge. Such stability in the ion concentrations also supports the hypothesis that groundwater was the dominant component in the storm discharge. These results suggest that the aquifer system in the Cedar River watershed efficiently interacts with the surface drainage system during storm events when contaminated water is released from groundwater storage.

114. Nutrient concentrations and distribution within the Iowa River alluvial aquifer, Iowa County, Iowa, 1996

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The Iowa River alluvial aquifer in the northwest corner of Iowa County, Iowa underlies an area of extensive agricultural activity, where nitrogen-based fertilizers are extensively used. The US Geological Survey sampled 23 wells at 13 sites over a three-week period during the summer of 1996 as part of the National Water Quality Assessment program. Nitrate was found above the detection limit in 21 of the 23 wells. Three wells had nitrate concentrations above the

US Environmental Protection Agency's Maximum Contaminant Level of 10.0 milligrams per liter (mg/L) for drinking water. Phosphorus was detected in 20 of the 23 wells. Well nests at five sites show two distinct vertical distributions of nitrate: decreasing concentration with increasing depth and increasing then decreasing concentration with increasing depth. The maximum variation in concentration for nitrate within a single well nest is 16.3 mg/L. The phosphorus concentration varied less than 0.12 mg/L vertically in all five well nests. No areal distribution pattern was found for nitrate or phosphorus.

115. Pesticides in ground-water of the Iowa River Corridor; an area of changing land use

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Twenty-three monitoring wells, ranging in depth from 9 feet to 40 feet, were sampled in the summer of 1996 as part of a US Geological Survey investigation of the effects of changing land use on ground water quality in the Iowa River alluvial aquifer. Approximately thirty percent of the crop land on the Iowa River Corridor, a region bounded by bluffs along the Iowa River between Tama and Amana, is being taken out of production as part of the Iowa River Corridor Project.

Atrazine, metolachlor, cyanazine, acetochlor, and metribuzin were detected at or above the method detection limit. Atrazine was detected in 11 of the wells, metolachlor in 6, cyanazine in 3, acetochlor in 2, and metribuzin in 1. Of these five pesticides, metolachlor, cyanazine, acetochlor, and metribuzin decreased in concentration with increased well depth within well nests. There was no general trend for atrazine. None of the pesticides exceeded the USEPA's maximum contaminant levels.

116. Agricultural drainage-well closures and groundwater quality response in Floyd County, Iowa

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An agricultural drainage well (ADW) is a drilled shaft that funnels excess drainage water into the underlying bedrock. Since 1984, the GSB has monitored the effects of ADWs on groundwater quality in the Devonian System aquifers beneath central Floyd County. Results from a GSB "nest" of four bedrock wells drilled to various depths showed that the ADWs were delivering agricultural contaminants (nitrate and

pesticides) into the groundwater of the aquifer, otherwise naturally protected by 30 feet of glacial till. In December 1994, as part of the Floyd County Groundwater Protection Project, the three ADWs (two 65-foot deep; one 350-foot deep) nearest the GSB well nest were closed. Drainage from the ADWs was diverted to a constructed ditch which empties into Beaver Creek. At the same time, the GSB initiated the "Floyd County ADW Closure Project" to monitor groundwater quality improvements resulting from closure of the three ADWs. Since closure, some nearby monitored private wells have shown improved water quality; others have not. The private well closest to the ADWs showed the most significant response; nitrate-N concentrations declined from 15.6 mg/L to < 3 mg/L. Nitrate-N declined in all bedrock wells; concentrations in the deepest well dropped below detection after closure of the ADWs. All but the shallowest bedrock well have shown a decline in the frequency of atrazine detections since closure. A 29-foot well, completed in glacial till and located near the bedrock well nest, has shown an increase in nitrate-N and in the frequency of atrazine detections during the monitoring period.

117. Groundwater monitoring at earthen manure storage structures

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Groundwater quality has been monitored for three years at three earthen manure storage (EMS) structures in Iowa. These are located in areas with differing surficial geologic materials: the Des Moines Lobe (DML) region, the Iowan Erosion Surface (IES) region, and the thick loess region. Three to seven shallow (<25 ft) monitoring wells are installed around each structure. At two sites wells were drilled through the berm on the downgradient side of the structures, while the third is ringed by a drainage tile that serves as a near-structure sampling point. Water levels are measured and water samples are collected monthly for nitrate-N, ammonia-N, fecal coliform bacteria, and chloride analysis. Samples are analyzed quarterly for total organic carbon, sulfate, phosphate, and other parameters. Samples of liquid manure from two of the structures have also been analyzed. Seepage of liquid has been detected at the DML and IES sites. Indications of seepage have been similar at all affected monitoring wells and include: the decline or loss of nitrate-N and sulfate, likely in response to the anaerobic nature of the liquid; and an increase in concentrations of chloride and total organic carbon. Chloride concentrations in the berm well at the DML site are 50% of those measured in the liquid waste; at the IES site, berm well concentrations equal those in the liquid

waste. Concentrations of nutrients, such as ammonia-N, phosphate, and potassium, have currently not increased, indicating these species are being absorbed and retained on manure solids or the compacted soils at the base of the structures. Fecal coliform bacteria have been sporadically detected in the berm wells, but are not consistently transported from the structures.

118. Hydrologic implications for siting large-scale waste containment systems on the Des Moines Lobe in Iowa

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An extensive system of linked-depression systems is developed on many parts of the Des Moines Lobe (DML) in Iowa. Linked-depression systems consist of a series of semi-closed depressions that have one or more "outlets" across saddle-like areas. These chain-like drainage features are developed within a debris-rich stagnant glacier and now function as a shallow subsurface drainage system that delivers shallow groundwater to major surface drainage elements. Linked-depression systems form preferential pathways for shallow groundwater movement on the DML in Iowa and travel time of contaminants is enhanced by the relatively high permeability of deposits associated with the linked-depression systems. Large-scale waste-containment systems in north-central Iowa are constructed in and adjacent to linked-depression systems and extensive sections of lagoon walls are composed of highly variable and permeable stratified diamicton.

Groundwater monitoring investigations at a waste-containment basin on the DML indicate that seepage occurs downgradient of the facility. Documenting linked-depression system distribution and monitoring subsurface groundwater flow paths and velocities in these areas is essential for the evaluation of nonpoint source pollution on the DML in Iowa. Geographical information systems (GIS) analysis of soil survey data and surficial geologic maps supply us with county-scale assessments that provide specific information for management decisions, target pertinent field research investigations and help generate research questions.

119. Comparison of dual porosity and discrete fracture models for evaluating solute transport in fractured till

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Two methods, herein termed the Dual Porosity Model (DPM) and the Discrete Fracture Model (DFM) methods, can be used to describe solute transport processes in fractured till in Iowa. The DPM method was developed by soil physicists to describe advection-dispersion phenomena and solute transport in soil columns. The DFM method was developed by hydrogeologists to allow incorporation of fracture geometry into solute transport models. Because of the mathematical and conceptual similarity between the DPM and DFM methods, we hypothesized that they could be used together to investigate solute transport in a fractured till. To test this hypothesis, we excavated large (0.45 m diameter x 0.45 m long) cores of late Wisconsinan till (Dows Fm.) near Ames, Iowa, and transported them undisturbed to the laboratory. Solute tracer experiments using C1 and Br were conducted on the cores and breakthrough curves were generated. The computer program CXTFIT was used to fit the DPM to the breakthrough curves to allow estimation of solute transport parameters (i.e., mass exchange coefficient, α). The USGS MODFLOW and MT3D models were then used to simulate breakthrough curves based on fracture patterns observed during excavation of the cores and transport parameters estimated by CXTFIT. The DFM method of incorporating matrix diffusion simulated the form of the laboratory breakthrough curves successfully. The results of this preliminary study suggest that a combination of the DPM and DFM methods provides an improved evaluation of solute transport in fractured till.

120. The study of surfactant recycling by counter-current solvent extraction

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As part of a study of surfactant-aided remediation of organic contaminants, counter-current solvent extraction was investigated to determine its efficiency for used surfactant recycling. The experiments used two glass columns 70 cm high with an internal diameter of 3 cm. At the base of the column, two different counter-current orifice designs were tested. One was a "T" shaped tube (8 mm o.d.) and the other was a "convex" tube with four

holes (4 mm o.d.). Two percent aqueous surfactant solutions containing toluene as model contaminant were poured into the column. Hexane was used as the counter-current solvent. Using a pump, hexane was cycled upward through the surfactant solutions. Samples were taken via the sample port at the bottom of the column, and then analyzed by GC. The convex orifice system with a hexane flow rate of 30 ml/min. gave the maximum efficiency for anionic surfactant solution recycling.

This study suggests that counter-current solvent extraction methods may help to recycle anionic surfactant solutions used for remediation of contaminated soil.

POSTERS

121. Modeling of a prairie pothole wetland on the Des Moines Lobe

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The purpose of this study is to obtain a calibrated model to predict how changes in climate could affect the health of a prairie pothole wetland located on the Des Moines Lobe, seven miles north of Des Moines, Iowa at the Camp Dodge National Guard Base. Data was collected from May to November of 1996. A detailed topographic map was constructed from a stadia survey. A total of seventeen observation wells were installed and monitored to supplement two well nests which were equipped with continuous water level recorders. Hydraulic conductivities were determined from slug tests and generating field curves using the program AQUIFERTEST. A surface water level gauge measured maximum fluctuations in water depth. A NOAA climate station is located within one mile of the wetland and provided continuous precipitation and temperature measurements. Evaporation and evapotranspiration were obtained from standard field devices.

The above data will be entered into MODFLOW in order to determine the head distribution of the wetland area. A key to understanding the conceptual model will be to determine the extent of highly conductive sand channels in the linked depression framework of the Des Moines Lobe. A one-layer model should be sufficient to simulate a probable distribution of hydraulic conductivities. A calibrated model is important in understanding the dynamics of groundwater discharge and recharge to the system, and it will be able to predict future fluctuations in this unique ecosystem.

PHYSICS

122. Hurricanes in the eastern Pacific

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Hurricanes in the eastern Pacific Ocean offer interesting research prospects. Hurricane genesis typically occurs in a preferred area off the west coast of Central America. Hurricanes in this basin also offer a unique opportunity to study the dissipating influences on hurricanes, since the majority of these hurricanes dissipate within the eastern Pacific hurricane basin. The effect of sea-surface temperature, wind shears, orographic lifting, and easterly waves on hurricane genesis were explored in the paper. Data obtained from the National Center for Atmospheric Research (NCAR) was used in this project.

123. Physics between social myth and sacred cow

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Introductory physics teaching inevitably begins by addressing generalities such as "what is science?" as well as past "paradigmatic" achievements of the field. Introductions of this kind rely on terms such as *scientific method*, *unbiased observation*, *hypothesis formation*, *experimental verification*, etc. All of these concepts have come in for profound criticism, but in educational practice methodological criticism is virtually ignored. Apparently physics educators fear that the only alternative to the traditional picture is wholesale relativism and sellout to pseudo-science. This attitude is counter-productive when dealing with contemporary challenges to the role of science.

The possibility of finding middle ground can be illustrated by a current controversy over the role of the Michelson-Morley experiment as evidence for (or even against?) Special Relativity. Some of the discrepancies between various accounts can be understood by considering the different aims of, respectively, professional history and pedagogical examples. Beginning physics students are not failed historians, but learn from historical examples about their field's situation within the social context.

This process is akin to initiations studied by anthropologists, an analogy often vigorously resisted by educators. The reasons for this resistance are historically understandable, but they are no longer valid. Much can be learned by comparing the pedagogical process in physics (and natural sciences

in general) to other initiations. Contrary to the suspicion that this will make physics "merely another creation myth," this comparison reveals features that are distinctive as well as some that are shared. In particular, factual accuracy in the portrayal of history is essential to science pedagogy. To the extent that the heroic narratives found in textbooks reflect propaganda rather than accurate history, both the pedagogical aims and the practice of science suffer.

124. Wave normal vector calculations using the Polar Plasma Wave Instrument

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The Plasma Wave Instrument on the Polar spacecraft is designed to study magnetospheric plasma wave emissions along an orbit with apogee at 9 Earth radii, perigee at 1.8 Earth radii, and inclination within 5° of 90°. Five receiver systems are used to measure emissions between 0.1 Hz and 800 kHz. The High-Frequency Waveform Receiver (HFWR) is the first receiver designed at the University of Iowa to simultaneously provide six orthogonal measurements of electric and magnetic signals. The HFWR can operate in one of two modes. In the low-telemetry rate mode, simultaneous waveform snapshots of the six electric and magnetic field measurements are produced once every 128.8 seconds. In the high-telemetry rate mode the waveform snapshots are produced once every 9.2 seconds. The measurement of three-axis electric and three-axis magnetic wave fields allows the direct calculation of wave normal direction, polarization characteristics and Poynting flux using experimental data. A polarization analysis of equatorial plasma wave emissions is performed to show that these are coherent electromagnetic waves. The wave normal vector and Poynting flux are computed in order to determine the location of the source region of these waves.

POSTERS

125. Beam ratio and image quality in low-power, reflection holography

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Holography is a useful tool in studying aspects of physical and quantum optics. However, due to expense, many instructors view it as unavailable for teaching purposes. The purpose of this experiment was to determine if more complex, and expensive,

holographic configurations produced results that were significantly better than the images produced in the simplest possible arrangement. In particular, intermodulation noise was a major concern. Intermodulation noise occurs when spurious interference fringes are recorded on the photographic emulsion of the hologram. Intermodulation noise can be controlled by controlling the power of the object beam in relation to the power of the reference beam. The relative power in the reference and object beams is called the beam ratio. The beam ratio is usually controlled by establishing separate object and reference beams and working with a multiple-beam arrangement. However, it is possible to form a reflection hologram using a single-beam configuration. The single-beam configuration does not permit control of the beam ratio.

In our experiment we compared the images produced in the simple, single-beam configuration to images produced in multiple-beam configurations. We found that for two different types of objects the image quality was not significantly better in the multiple-beam configurations as compared to the single-beam arrangement. This result is important because a single-beam holographic arrangement is much simpler and less expensive than other approaches, and yet it produced results that are quite impressive and acceptable when compared to more expensive alternatives. Holograms that were produced will be available for viewing.

126. Transport phenomena in the narrow energy band materials

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Many recently developed and widely used materials such as high temperature superconductors, rare earth and transition metal compounds, and some quasi organic substances are characterized by the presence of narrow energy bands. The electron-hole description, constant effective mass approach and many classical kinetic theory formulas are not valid anymore in such systems. The reason is due to the thermal redistribution of the electrons over the narrow energy band. The situation is complicated even more in materials, which undergo phase transition. It is hard to describe the electron behavior in terms of the effective mass when the electron energy spectrum is changing.

One of the possible theoretical descriptions of the narrow energy band statistical and kinetic properties is based on the application of the Green function technique. In this work this technique was elaborated for the self-consistent calculation of the conductivity, Hall and Verdet coefficients and thermoemf in the systems with interelectron and electron-phonon correlations. Some of the models investigated are: the

model of the noninteracting electron system in the narrow energy band; the Hubbard Hamiltonian that takes into account the strong on-site electron correlation, the extended Hubbard model that describes systems with possible phase transition into the charge-ordered state (COS). The common feature of the obtained results for different models is the kinetic coefficient's signs dependence upon the number of electrons in the narrow band. It has been shown also that splitting the energy band during COS transition affects the magnitudes and signs of the Hall, Verdet and thermoemf coefficients.

PHYSIOLOGY

127. Interactive customized electrocardiography teaching software for students, residents, and practicing physicians

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Teaching clinical electrocardiography to students, residents, and practicing physicians is an important requisite in medical education. However, traditional methods require an intensive time commitment from the teaching faculty and require the student learn at a pre-determined rate and format. We are developing a unique PC-based tool for instruction which provides a more efficient self-paced instructional method for learning electrocardiography. This tool should offer both instruction and assessment and require minimal instructor input. A large number of classic electrocardiograms collected over a 20 year period by the teaching faculty have been digitized to form the foundation of this teaching tool. Electrocardiograms are organized into a review of normal tracings and abnormal tracings which are further divided into classical pathological heart conditions. The normal section includes an innovative, interactive strategy on assessing ECGs. After the initial review, the software offers practice sessions for self-assessment which include random ECGs and multiple choice questions.

The finished product is to be compiled onto a CD ROM. Also planned is an evaluation of the software by students and postgraduate users. This approach of teaching clinical electrocardiography circumvents many of the disadvantages of traditional methods and provides an easily implemented tool for group and individual education. It utilizes the ever-increasing and pervasive computer technology and provides an alternative strategy for learning and/or reviewing electrocardiography locally or from remote sites.

128. Network-based teaching and consultation for 3-D physiologic imaging

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Our laboratory has demonstrated the utility of high speed, multislice (volumetric) X-ray CT for accurately assessing lung and cardiac structure and function relationships. CT-based studies have shown measurement accuracy for lung and cardiac volumes. Imaging methods are available to evaluate the physiologic characteristics in the lung periphery including regional ventilation, perfusion, and underlying parenchymal pathology. Imaging and image analysis have been used to assess regional airway reactivity, mechanics of speech formation, and heart-lung interactions. We are determining the clinical applicability of physiologic imaging and image analysis, and to make these advanced technologies available to the rural practice of medicine.

Highly trained technologists are required to make effective use of quantitative and descriptive volumetric imaging methods. Although tools for image acquisition are available to rural sites by means of mobile units, the expertise to make effective use of image data is often missing. We have integrated our UNIX based quantitative image display and analysis package "VIDA" into a telephysiologic imaging workstation which allows for sharing of image data sets between the university and rural sites with network based voice transmission and image based manipulations. Hardware is deployed which allows for control of lung volume during scanning to assure high quality volumetric image acquisition. On the Internet (<http://everest.radiology.uiowa.edu/>), tutorials are supplied to teach clinical applications. We are now on-line providing real-time consultations to remote Iowa hospitals: the Van Buren County Hospital in Keosauqua and the Ottumwa Regional Medical Center in Ottumwa. Supported in part by a National Library of Medicine grant NO1-NLM-4-3511 US PHS.

129. "Virtual Physiology" - contributions of computer simulations to physiological education

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Traditionally, animal laboratories have been an integral part of physiology courses, providing students with active participation and exposure to experimental design. Unfortunately, animal concerns, costs and increasing demands on faculty time and resources are

causing traditional laboratories to be offered less frequently. Alternatively, computer simulations of physiological systems have been proposed as a substitute for traditional laboratories. "Virtual laboratories" solve many of the problems with traditional laboratories and have the further advantages that students can access the software independently, and more physiological parameters can be manipulated. Our presentation will describe our experience incorporating computer simulations into the teaching of physiology.

Simulations were incorporated into four physiology courses (600-700 medical, dental, nursing, pharmacy, physician assistant, graduate and undergraduate students). The required laboratories were based on two commercial products: *Simbiosys* (312-240-0403) and *Virtual Heart* (CAE Electronics, Binghamton, NY). Each laboratory was held in a computer classroom (24 Mac/Win computers), with 2-3 students (40-60/session) at each computer and 6 faculty/instructors. Like traditional laboratories, students were provided with specific instructions for each experiment. Currently, two respiratory and three cardiovascular laboratories have been developed. Based on attitude surveys, students strongly believed that the computer experiments helped them to understand the course material.

130. Computerized tutorials for instruction in endocrinology and reproductive physiology

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Computer-based programs for instruction in the physiological sciences are being used on an increasing basis to replace or supplement animal laboratories. This technology also offers new forms of student-instructor interaction and various modalities for the presentation of materials integral to the mission of educational institutions.

It is essential that instructors are provided the means to select the materials presented to students and can control the manner in which these materials are displayed and obtain feedback related to student usage and performance. Many of the computerized programs available for physiological instruction do not allow for extensive instructor input and control of the selection of materials and their presentation. Authoring programs such Authorware™ provide the means for educators to develop new materials or to adapt existing educational materials for presentation using computer facilities at either local or remote sites.

The basic elements that are involved in the development and authoring of programs will be described. Perceived advantages and disadvantages of computerized tutorials and limitations and time commit-

ments associated with such activities will be identified. Programs developed with the Authorware™ system as "pre-tests" of topics covered in endocrinology and reproductive physiology or as part of board certification tests will be demonstrated. These will include examples of various question/response formats along with examples of exercises which integrate the presentation of text and slide materials within a menu-based program.

131. Frontiers in Physiology: The APS summer research program for middle and high school teachers

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Program goals are for: teachers to learn about "science in action," transference of knowledge from research experience to classroom, and networking between teachers and researchers. Teachers will pursue 7-9 weeks of research in a physiology laboratory and attend both a Summer Retreat and the annual APS Meeting. The fellowship includes a stipend, travel to the retreat and to the meeting, and a mini-grant for developing research experience into classroom activity. Contact people in Iowa who are members of APS as well as IPS and/or IAS include: Richard Engen at Iowa State Univ, Luke Mortensen at Univ of Osteopathic Med, and David Gutterman, Carl Gisolfi, Robert Fellows, Kevin Campbell, or Ulla Kopp at Univ of Iowa. The next application deadline will be on or about January 5, 1998.

132. Clinical study for implementation of cardiac Troponin-I testing

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Approximately 30,000 Americans with acute myocardial infarction are misdiagnosed in hospitals each year, the two extremes of undertreatment and overtreatment both have serious implications. The definition of acute myocardial infarction is not constant among clinicians, yet generally includes a patient history of chest pain, EKG changes, and an increase in blood serum concentration of cardiac markers. The present standard marker is Creatine Kinase-MB. Common existing techniques for Creatine Kinase-MB measurement are either very time-consuming and technique-dependent, creating possible delays in treatment and inconsistent results, or rapid and excessively sensitive, leading to false positive results.

In the present clinical setting these techniques are workable but are far from ideal. In mid-November 1996, Mercy Medical Center in Cedar Rapids began to offer Troponin-I testing for clinical evaluation as a non-orderable supplement to the existing Creatine Kinase isoenzyme test and with the more rapid CK-MB screen. Commercial testing for cardiac Troponin-I has been available for approximately two years and has been praised by many for its increased specificity to detect myocardial injury and allow the distinction of myocardial injury from other causes of serum Creatine Kinase elevation with fewer errors than other techniques. From the inception of Troponin-I testing at Mercy Medical Center over 400 test procedures on over 150 patients have been performed. This study is to aid in the evaluation of Troponin-I testing, and the present Creatine Kinase-MB testing in the clinical setting at Mercy Medical Center.

133. Evaluation of bifocal gradient gel electrophoresis for the determination of LDL particle size in human plasma

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Plasma low-density lipoproteins (LDL) are heterogeneous, differing in size, density and chemical composition. Recent studies indicate that a preponderance of small, dense LDL is associated with an increased risk of coronary artery disease. In this study, the diameters of the predominant peak of LDL particles were determined in 50 human plasma samples using nondenaturing polyacrylamide gradient gel electrophoresis and densitometric scans of lipid stained gels. Two gradient gel systems were evaluated; a new bifocal gradient gel (0.75-22%, BGG) was compared to a standard gradient gel (2-16%, SGG). Mean±SD values for calculated LDL particle size were similar for the BGG (260.4±4.8 Å, angstroms) and SGG (260.2±8.7 Å). However, there was a modest correlation ($r = 0.70$, $P < 0.05$) between the two gel systems. Between the two gels, deviations in LDL particle size averaged 4.9 ± 4.3 Å and ranged from 0-21 Å. Precision studies on the BGG showed that coefficients of variation were <3.5%, similar to CV values (~3%) reported for the SGG. Compared to BGG, SGG produced higher correlations between LDL particle size and plasma triglycerides ($r = 0.67$ vs 0.73), high-density lipoprotein cholesterol ($r = 0.55$ vs 0.71), and body mass index ($r = 0.60$ vs 0.72). Given that diet, exercise, and/or drugs may elicit only small changes (~5-10 Å) in LDL particle size, our findings indicate that the BGG may not yet be adequate for study of LDL subclasses. Notably, unlike SGG, BGG has the added advantage of providing data on HDL particle size.

134. Endothelin does not cause heat-induced vasoconstriction in isolated rat mesenteric arteries

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Isolated rat mesenteric artery segments (2-3 mm length, 223-417 μ m internal diameter) subjected to graded heating (37°C to 43°C over 60 min) significantly constrict (-13.0 \pm 2.8% at 39.5°C to -26.9 \pm 8.9% at 43°C) to a maximum at 42°C (-32.8 \pm 7.8%). Removing the endothelium blocks the response. To test the hypothesis that endothelin is released from the endothelium during heating and causes this constriction, isolated rat mesenteric artery segments were heated and endothelin-A (ET-A) receptors, which mediate vasoconstriction, were blocked using the receptor antagonist BQ610 (2 \cdot 10⁻⁹ to 8 \cdot 10⁻⁶M). The constrictor response was measured as a change in internal diameter using a microscope equipped with a video camera. The constrictor response to endothelin-1 (a potent ET-A receptor agonist), at doses that usually produce half-maximal to maximal constriction (10⁻⁹ to 8 \cdot 10⁻⁸M), was blocked at the end of the heating protocol. Blocking ET-A receptors did not significantly (p>0.05) attenuate the constrictor response to heating (maximal constriction -19.5 \pm 5.3% at 41.5°C). We conclude that although endothelin may be partially involved in the constrictor response to heating, it is not the primary endothelium-derived vasoconstrictor. Supported by NIH Grants: #HL38959, #HL14388; and Grant #AG12350.

135. Inducible hypertension in transgenic mice containing the human angiotensinogen gene under the control of the kidney androgen-regulated protein promoter

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We reported that double transgenic mice containing the human renin (hRen) and human angiotensinogen (hAng) genes exhibit chronic hypertension. Since hAng mRNA was widely expressed in liver, kidney, adipose, heart, and brain, hypertension may have resulted from the activation of tissue, as well as endocrine, renin-angiotensin systems (RAS). To examine the hypothesis that an intra-renal RAS is an important modulator of blood pressure and renal function we generated transgenic mice in which the kidney androgen-regulated protein (KAP) promoter was

used to specifically target hAng gene expression to the cortical proximal tubule cells (cPTC) of the kidney (KAP-hAng), the site of endogenous Ang expression in this organ. Northern blot analysis demonstrated that KAP-hAng mRNA was highly expressed in the kidney of male mice but not female mice. However, hAng mRNA could be dramatically induced in female mice after administration of testosterone (T). In contrast to transgenic mice containing the hAng gene under the control of its own promoter, there was no evidence of KAP-hAng mRNA in the liver, heart or brain. In situ hybridization studies revealed that the transgene was faithfully expressed in cPTCs. Blood pressure was measured in conscious and freely-moving double transgenic mice containing both the KAP-hAng and hRen transgenes using an indwelling carotid arterial catheter. MAP was elevated by approximately 30 mmHg in hRen/KAP-hAng males but was normal in females. However, an increase in MAP in the female hRen/KAP-hAng mice could be induced by administration of T. These data support the hypothesis that intra-renal activation of the RAS participates in the pathogenesis of hypertension. Moreover, these mice should provide a novel model of inducible hypertension.

136. Ovulatory responses of New Zealand White rabbits treated with commercial gonadotropins: FSH-P™ or SUPER-OV®

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The effects of superovulatory treatment with frozen-thawed preparations of two commercial gonadotropins (FSH-P™, Schering-Plough Animal Health Corp, Kenilworth, NJ; SUPER-OV®, Ausa International, Inc., Tyler, TX) were evaluated in twenty New Zealand White (NZW) rabbits. Does (>3.0 kg of body weight) were given 0.3 ml subcutaneous injections containing 0.3 mg Armour Standard of FSH-P or SUPER-OV twice daily for three consecutive days. Does were then given an intramuscular injection of hCG (25 IU/kg) six hours after the last FSH injection and paired overnight with a fertile male. Nineteen hours after hCG administration, the ovaries were removed and the oviducts were flushed to recover embryos.

The mean (\pm SD) rate for ovulation of FSH-P-treated does (34 \pm 12) was higher (P < 0.005) than for SUPER-OV-treated does (19 \pm 6) and more (P < 0.005) embryos were recovered after treatment with FSH-P (29 \pm 11) than with SUPER-OV (15 \pm 6). The ovaries from FSH-P-treated does had more (P < 0.05) hemorrhagic follicles (11 \pm 16) than those of SUPER-OV-treated does (0.1 \pm 0.3).

Treatment of NZW does with FSH-P resulted in

more ovulations and recovered embryos than were obtained with SUPER-OV.

POSTERS

137. Advantages of the MacLab over "stand-alone" chart recorders and oscilloscopes in teaching a physiology laboratory course

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The undergraduate physiology laboratory has recently been upgraded to make use of computer-aided data acquisition systems to replace the aging and now outdated older technology of stand-alone electronic chart recorders and oscilloscopes. The MacLab is a peripheral hardware device which is controlled by the Apple Macintosh computer. When used with the scope software package it allows the computer to operate as an oscilloscope, and when used with the chart software package allows the computer to operate as a chart recorder. The MacLab can also operate as an electronic stimulator. Students are much more comfortable with this system than with the former stand-alone hardware largely because they are already familiar with computers and menus and need only learn how to connect the preparation to the transducers. Reading the magnitude and duration of responses is easily and accurately done using the mouse arrow. Recording data points to an electronic data pad requires a double click. Electronically recorded data is easily transferred to spreadsheets or statistical and graphing packages. Multiple responses can easily be overlaid for comparison. Recorded data on one channel can be converted and displayed on another channel through the use of a large number of computed input functions. The entire exercise can be replayed in real time for later review. Each student can even save the response on a disc and analyze it later using the full power of the MacLab at home on their own computers by linking up to the Chart and Scope Software on the Biology Department Server. Exercises which used to take a full three hours to run are now routinely done in two. The bonus time is utilized for discussion or to run exercises over again a second time.

138. Teaching basic electrophysiology to medical students using computer-aided instruction (CAI)

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From 1990 to 1994 medical students at Univ of Miss Medical Center were taught Basic Electrophysiology using Randall's CAI package (Microcomputers and Physiological Simulation, 2nd ed., New York: Raven, 1987) to reinforce lecture. This DOS program [being updated for Windows] includes: 1) programmed instruction on diffusion, electrochemical driving force, conductances and currents; and 2) interactive models of action potentials (squid axon), saltatory conduction and single channels.

Students followed one of two patterns. With at least one instructor per twelve students actively facilitating learning, students demonstrated subject mastery and reported satisfaction. With inadequate staffing students moved quickly through the programmed instruction, demonstrated poor understanding, and reported dissatisfaction. The latter students scrolled through the programmed instruction ignoring text and focused on the interactive models, which confused or were meaningless to students lacking adequate background or perspective. Also, a coach was usually required to help students extract the significance of conductances, channel states, and other information from the interactive models. The squid axon model is often used as a stand alone or self-instructional - frequently to save instructional effort. It is predictably not useful in either capacity. However, the model can be used to assure student mastery when combined with adequate student preparation and coaching.

139. Insulin and IGF-1 induced vasodilation in rat aorta and canine coronary arteries

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Insulin and insulin growth factor 1 (IGF-1) are related peptides capable of stimulating metabolic and mitogenic processes. Mechanisms of insulin-induced dilation are not understood. This study examined mechanisms of vascular dilation to insulin and IGF-1. Rat aorta and coronary arteries from mongrel dogs (5-8 kg) were mounted onto stainless steel stirrups in 5 ml organ baths, containing warmed (37°C), oxygenated Krebs's buffer. Vessels were equilibrated at optimal

isometric tension then incubated in control solution L-NNA (100 μ M), L-NMMA (100 μ M), tetraethylammonium chloride (TEA, 10 μ M or 1 mM), or L-NMMA and TEA for 30 minutes. After constriction with PGF_{2 α} , cumulative doses of insulin or IGF-1 (0.1-100 ng/ml), were added to the bath and tensions were recorded. Results: L-NMMA or TEA alone did not alter the dilator response to insulin in rat aorta. In contrast, IGF-1 induced dilation was reduced by L-NMMA or TEA, and by L-NMMA and TEA combined (see Table). In canine coronary arteries, insulin and IGF-1 induced dilation was not altered by any of the inhibitors.

Maximal Percent Relaxation of Rat Aorta to IGF-1 Mean \pm SEM *p<0.05 vs control			
control	L-NMMA	TEA	L-NMMA+TEA
55.0 \pm 3.9	33.1 \pm 7.8*	33.0 \pm 3.3*	23.0 \pm 6.1*

We conclude that in rat aorta and canine coronary arteries, insulin induced dilation is independent of nitric oxide or K⁺_[Ca²⁺] channels, however both mechanisms contribute to IGF-1 induced dilation in rat aorta.

140. Methionine oxidation regulates N-type inactivation in Shaker potassium channels

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Ion channels are transmembrane proteins which are the fundamental units responsible for cellular excitability in addition to playing many roles in maintaining general physiological homeostasis. These channel proteins are regulated by a variety of mechanisms. The oxidation or reduction of amino acids is one such regulatory tool which the body utilizes to control ion flux through the channels. Oxidation of methionine residues in structural proteins plays important physiological and pathophysiological roles. To study the importance of methionine oxidation as a dynamic regulatory process, we studied voltage-dependent Shaker C/B potassium channels heterologously expressed in *Xenopus* oocytes.

We found that the voltage dependent Shaker C/B potassium channel shows broad variability in its inactivation rate. We hypothesized that different oxidative states of the methionine in the channel's amino terminus account for this variability. More specifically, fast N-type inactivation is disrupted when the amino terminal methionine is oxidized to a sulfoxide. Consistent with this hypothesis, application of the oxidant, Chloramine-T, caused a loss of N-type inactivation. Furthermore, mutation of the methionine to leucine accelerated the channel inactivation and

eliminated variability. To test physiological relevance, the enzyme methionine sulfoxide reductase was co-expressed with Shaker C/B channels. The methionine reductase co-expression specifically increased the N-type inactivation rate. These results indicate that the oxidation of an amino terminal methionine reversibly disrupts N-type inactivation. We are now extending this work by examining the effects of methionine oxidation on other physiologically important channels such as those involved in cardiac arrhythmia.

141. Effects of pre-hemorrhage fasting

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Believed to decrease the risk of aspiration, pre-surgery fasting is common. We investigated the effects of pre-hemorrhage fasting in a hemorrhage and resuscitation model.

Methods: With (F, n=74) or without (NF, n=23) an 18 hr pre-hemorrhage fast, male Wistar-Furth rats were anesthetized, hemorrhaged (MAP=35-40 mmHg) for 90 min, and resuscitated (MAP>80 mmHg) for 3 hr with 7.8% NaCl in 6% dextran 70, lactated Ringer's, or 6% dextran 70 in lactated Ringer's. Survivors were euthanized at 48 hr.

Results: Fluid groups were too small for independent comparisons. Colon intraluminal PCO₂ (mmHg)

Group	Start H	Start R	2 hr R
NF survived	59 \pm 3	66 \pm 3	52 \pm 1
NF died	69 \pm 3*	90 \pm 7*	59 \pm 3*
F survived	55 \pm 1	62 \pm 2	43 \pm 1*
F died	55 \pm 1	59 \pm 2	39 \pm 1

H = hemorrhage, R = resuscitation. Mean \pm SE, *p<0.05 as compared to survivors (ANOVA).

Incidence of organ pathology and mortality

	Lung	Liver	Kidney	Small Intestine	Mortality
NF	0%	10%	60%	48%	35%
F	26%*	45%*	47%	85%*	66%*

* p<0.05 as compared to non-fasted (Chi-squared).

Conclusions: Fasting is an independent variable with significant effects on outcome. Whether pre-surgery fasting decreases the value of P_iCO₂ monitoring and increases patient risk should be determined.

142. Bradykinin stimulates substance P release from isolated rat renal pelvises

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Bradykinin (BK) administered to rat renal pelvises *in vivo* activates sensory receptors and causes a release of substance P (SP). It is not clear if SP is secreted from the pelvic wall itself or from some other renal tissue. To see if BK stimulates SP secretion from isolated renal pelvises, rat pelvises were dissected and placed into individual wells of a tissue culture plate containing 300 μ l of HEPES buffer containing 0.1% BSA, 10 μ M thiorphan, 100 μ M Phe-Ala, and 50 μ M maintained at 37°C and pH 7.4. The pelvises equilibrated for 50-70 min, with buffer changes every 10 min. The experiment consisted of two 10 min control periods, one 10 min experimental period when BK, 20 μ g/ml, was added to the incubation bath, and two 10 min recovery periods. Incubation buffer was changed after each period. An ELISA was used to determine SP content of the samples. BK increased SP secretion from 19.8 ± 2.6 to 34.1 ± 4.7 pg/ml; ($p < .01$). Following recovery, SP secretion dropped to 13.9 ± 2.0 pg/ml. Reducing calcium in the buffer reduced basal and BK-stimulated SP release. We conclude that SP is present within the pelvic wall, and can be released by stimulating BK receptors in the pelvic wall.

143. Activation of protein kinase C (PKC) results in a prostaglandin (PG) dependent release of substance P

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PKC increases afferent renal nerve activity (ARNA) and is involved in the increase in ARNA produced by bradykinin. The ARNA response to bradykinin is due to a PC dependent release of substance P (SP). We now examined if PKC activation by the phorbol ester PDBu increased urinary excretion of SP and if the increase in ARNA and SP produced by PDBu was altered by the PG synthesis inhibitor indomethacin. In anesthetized rats, PDBu (1 μ M) was perfused into the renal pelvis in the presence of indomethacin (50 μ g/ml) or vehicle. ARNA was expressed as percent of baseline. * $p < 0.05$, ** $p < 0.01$ vs control.

	Vehicle(n=12)		Indomethacin (n=8)	
	Control	PDBU	Control	PDBU
ARNA	96 \pm 1	130 \pm 4**	98 \pm 2	101 \pm 2
SP, pg/min	10 \pm 2	31 \pm 6**	8 \pm 3	10 \pm 4*

PDBu resulted increases in ARNA and SP that were blocked by indomethacin. Conclusion: PKC activation stimulates renal pelvic sensory receptors via a PG dependent release of SP.

144. Jun mutants repress glucocorticoid mediated transcriptional activity of reporter genes in transfected COS-7 cells

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The AP-1 transcription factor (c-jun homodimer or a c-jun/c-fos heterodimer) can interact with another transcription regulator, the intracellular glucocorticoid receptor (GR). Using COS-7 cells transiently transfected with the mouse mammary tumor virus promoter-luciferase reporter construct (pMTV-Luc), the interaction between these two pathways was analyzed. COS-7 cells were co-transfected with pMTV-Luc, human GR, and either wild-type c-jun or TAM-67, a dominant negative jun mutant lacking the transactivation domain. When incubated with a synthetic GR agonist (1 μ M RU28362), cells co-transfected with TAM-67 exhibited a dose-dependent repression (5-10 fold) of the GR-mediated induction of luciferase activity. COS-7 cells were also co-transfected with GR and pGRE₂-CAT, a purely glucocorticoid responsive promoter linked to the chloramphenicol acetyltransferase (CAT) gene. TAM-67 repressed the GR-mediated induction of CAT activity by 10-fold, suggesting that the repression by this mutant does not require DNA binding. Two jun DNA binding mutants, DBM-1 and CLA-1, were also co-transfected along with GR and pMTV-Luc into COS-7 cells. Both mutants repressed the GR-mediated response similar to TAM-67, providing further evidence that these jun mutants repress glucocorticoid-induced transcription by a non-DNA binding mechanism. In conclusion, all three jun mutants block GR-mediated transcriptional responses, possibly via their ability to form nonfunctional dimers with endogenous wild-type c-jun.

145. The effect of body fat on macronutrient utilization in cats fed low and high fat diets

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The present study was undertaken to determine whether cats with varying degrees of body fatness increase lipid oxidation with increasing dietary fat consumption. We determined the macronutrient oxidation based on the respiratory quotient (RQ) in four lean and two fat (5.6 vs 19.3% body fat) vasectomized male (VM), and two lean and four fat (6.0 vs 21.4% body fat) ovariectomized female (OF) adult cats during isocaloric feeding at maintenance levels of a low (6.6% wt fat, 13.4% wt protein) and a high (10.9% wt fat, 9.8% wt protein) fat canned diet. Body composition was determined by DEXA. Each diet was fed for eight days and RQ was determined by whole-body indirect calorimetry on day eight.

Data were analyzed using two-way ANOVA with body fat and sex status as independent variables, and diet as a trial factor. Fat oxidation was significantly ($p < .05$) increased on the high fat diet, in all groups except high body fat OF. VM showed a greater increase in fat oxidation on the high fat diet than OF (1.4 vs 0.9 g/kg, $p = .032$), with no difference in fat intakes. The two leaner OF cats had a greater increase in fat and protein oxidation from the low to high fat diet than fatter OF. There was no significant ($p < .05$) difference between fat oxidation in low or high body fat VM. These results suggest that cats maintain body weight during short term feeding of a high fat diet by increasing fat oxidation. The failure of high body fat OF to increase fat oxidation with increasing fat intake may indicate increased susceptibility to the development of obesity when fed diets with increased levels of dietary fat.

146. Locomotor rhythms of the fiddler crab *Uca subcylindrica* under artificial lighting

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Fiddler crabs were captured in south Texas and used in locomotor rhythm studies. Actographic data were analyzed using TAU[®] software. Under constant illumination (LL) and darkness (DD), *U. subcylindrica* express free-running locomotor rhythms with periods averaging 24.4 ± 0.1 h ($n=5$) and 24.0 ± 0.1 h ($n=21$), respectively. When exposed to LD_{12:12} activity is entrained by the photoperiod cycle. LD activity was generally bimodal with an initial burst about 0.5 h after

illumination. A second burst began 1 to 2 h before the end of illumination. This pattern persisted under several LD regimens. However, the crabs are arrhythmic under LD_{6:18}. When transferred from LD to LL, a locomotor rhythm with a period of 24.6 ± 1.0 h ($n=19$) is expressed. On the other hand, when placed in DD after LD, crabs are either arrhythmic or weakly rhythmic (23.8 ± 0.2 h; $n=5$). If the onset of illumination is advanced by 6 h, a period of less than 24.0 h is detected in the activity. When the onset of illumination was delayed by 6 or more h, a locomotor rhythm with a period greater than 24.0 h appears. The locomotor behavior of this fiddler crab species is not related to the tidal rhythms seen in other members of the genus. Rather, its behavior has a strong circadian component.

PSYCHOLOGY & LINGUISTICS

147. Mental rotation and the recognition of disoriented faces

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Previous research has shown that the time to recognize faces decreases monotonically as the faces are rotated in the picture plane. One explanation for this finding is that subjects must mentally rotate the face's image to upright prior to recognition. Alternatively, it is possible that the recognition costs observed for disorientation are due to decreased activation of the memory node responding to a particular face. The present experiments attempt to determine if mental rotation occurs during the recognition of misoriented faces. Subjects performed two tasks using rotated pictures of famous faces as stimuli: an identification task in which they had to determine the identity of a face or an orientation task in which they had to decide whether a face was pointing to the left or right.

The results show that the slope of the function relating amount of rotation to recognition time was four times steeper when performing the orientation task than when performing the identification task, suggesting that different processes were operating in the two tasks: mental rotation was likely being used to perform the orientation task while the costs observed in the identification task likely reflect decreased activation of the memory node corresponding to the face being recognized.

148. Interhemispheric cooperation and competition during visual information processing

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In this study, the previously reported hemispheric differences for local and global processing of visual information (Delis, Robertson, & Efron, 1985) were further assessed. Participants classified hierarchical visual stimuli (i.e., smaller letters arranged to form larger letters) on either their global configural aspects or the local elements comprising them. Specifically, we examined whether dividing a stimulus input between the two visual fields or simultaneously presenting the stimulus to both fields (i.e., when both hemispheres have access to the same stimulus information as compared to the condition when both hemispheres have to share information) is associated with an information processing advantage or penalty as compared to unilateral presentation of the same material to a single field (Exp. 1). We also investigated what impact concurrent verbal or spatial memory loads have on such processing (Exp. 2). In general, the results of the two experiments suggest that both competition and cooperation characterize interhemispheric interaction during visual information processing, and that concurrent memory loads influence the success of this processing partnership.

149. The coding of relative size in object representations

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Although all structural description theories of object recognition posit that some sort of relations between an object's primitives must be coded, little empirical research has been done to determine exactly what types of relations are included as part of the memory representation. A possible candidate for one type of relation that could be coded is relative size (i.e., whether one part is larger or smaller than another part). The purpose of the current investigation was to determine whether relative size is coded during the process of recognition.

A set of experiments was conducted using line drawings of two-part imaginary objects as stimuli. In each experiment the subject's task was to determine if two objects presented sequentially on a computer screen were composed of the same parts in the same configuration regardless of any size changes among the parts. In one condition (Metric Change) the size of one of the parts changed but relative size didn't (the

changed part was either bigger or smaller than the second-part in both objects). In the second condition (Categorical Change), the relative size of the parts did change. For both sets of experiments, it was harder for subjects to appreciate that two objects were composed of the same set of parts when there was a relative size change between the parts (Categorical Change condition) compared to when there was only a change in absolute size (Metric Change condition). The results suggest that the relative sizes among the parts of an object are coded in the representation used for object recognition.

POSTERS

150. Quantitatively and qualitatively representative toddler speech samples

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Spontaneous speech samples provide important data to aid speech-language pathologists in determining the presence of speech disorders and direction for remediation. In the current study, each sample's length and content were manipulated to determine their effects on sample reliability and representativeness. Spontaneous speech samples were taken from six subjects, ages 2:11 through 4:7, with moderate-to-severe and severe speech sound disorders. Test data were obtained from the *Bankson-Bernthal Test of Phonology*. Six samples were constructed for each child: a 450-word sample consisting of half play/half test activity data (used as a comparison for the other five samples), 300-word and 224-word samples consisting of half play/half test activity data, and 300-word, 224-word, and 150-word samples consisting of play activity only data. All samples were compared using four measures: initial consonant inventory, final consonant inventory, use of phonological processes, and percent consonants correct.

Results indicated that sample content did not significantly influence the reliability and representativeness of the samples. Sample length was a significant factor in the reliability and representativeness of the samples. Statistically, the 300-word sample consisting of half play/half test activities provided the most beneficial information. The four comparison measures varied in stability across the different samples. It was found that initial and final consonant inventories were less stable than use of phonological processes. The most stable measure was that of percent consonants correct.

ZOOLOGY

151. Iowa's Odonata: declining and/or changing?

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Three years ago we initiated a study of Iowa's dragonflies and damselflies. We planned to collect 1) in each county, 2) early, late, and middle of the flight season, 3) in a variety of habitats, and 4) a minimum of 30 species in each county. Analysis of our data suggests that all but the first objective were necessary to collect the species that we collected. To obtain equivalent results we might have sampled fewer counties, but probably not less than 75-80% of the them.

Our conclusions are based on the more than 8000 observations we have made in 94 of the state's 99 counties. We have collected 91 of the 107 species reported for the state. Fifteen species were found in 1-3 counties and are probably rare and the 18 species found in 60 or more counties are surely common. A comparison of our data with that of Whedon indicates that the distributional ranges of some species have expanded in the past 85 years and the ranges of others have contracted. Most of the 16 species that we have not collected are either rare, extinct, or never occurred in Iowa.

152. The epidemic of frogs with too many legs

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Bullfrogs (*Rana catesbeiana*) with extranumerary legs were collected during the summers of 1993 and 1994 in eastern Iowa. It was possible in 1994 to compare populations of metamorphosing frogs of the same age from four subgroups of closely associated populations at the same time. Presence of the abnormality and trematode metacercaria correlate significantly. A survey of nearby snakes showed the presence of a trematode believed to be *Paralechiorchis syntomentera* suspected of causing similiar limb abnormalities in California.

153. Molecular phylogenetics of North American softshell turtles (*Apalone*)

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The historical relationships of North American softshell turtles (*Apalone*) has been generally unappraised. Previous estimates based on morphology yield only an interspecific view of the genus resolving an ((*A. mutica*, *A. spinifera*) *A. ferox*) relationship. No information exists dealing with hypotheses of intraspecific relationships. The purpose of this study was to test the former phylogenetic hypotheses with molecular data and, additionally, establish a framework of intraspecific relationships within each of the three species.

We used a stretch of 800 bases of the mitochondrial cytochrome *b* DNA sequence in a parsimony analysis of the three North American species of *Apalone*. Our results resolve an ((*A. ferox*, *A. spinifera*) *A. mutica*) relationship which is not congruent with morphological hypotheses. Within the *A. mutica* and *A. spinifera* clades northern populations from Wisconsin, Illinois and Arkansas group together and are sister to southern populations from Louisiana, Alabama, and Florida. Large divergences between these intraspecific north-south clades are detected with sequence divergences as great as 4% for *A. mutica* and 2% for *A. spinifera*.

154. The influence of egg size upon nest-site selection in the painted turtle, *Chrysemys picta*

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Size is influential upon reproductive fitness in many species of animals. In the painted turtle (*Chrysemys picta*) large females are thought to benefit relatively more than large males in reproductive costs and offspring production. Due to temperature-dependent sex determination, nest-site selection by females may ultimately affect the sex-ratio of the offspring. Thus, one of several factors that may contribute to the potential benefits of "manipulating" the sex-ratio in *C. picta* is whether females with large eggs tend to lay them in warm, female-producing nest sites. This presentation will discuss trends of nest-site selection by female *C. picta* observed in field studies on the upper Mississippi River, and how these results will be incorporated into a model to describe how nest-site selection may influence the population sex ratio.

155. Changes in the distribution of Blanchard's cricket frog (*Acris crepitans blanchardi*)

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The historic range of Blanchard's cricket frog (*crepitans blanchardi*) included the southeastern and southwestern corners of Minnesota, the southeastern corner of South Dakota, the southern half of Wisconsin, and all of Iowa. This study examined historic and possible new cricket frog locations in southeastern and southwestern Minnesota, and throughout Iowa. The cricket frog seems to have been extirpated from both corners of Minnesota and the northern two tiers of Iowa, with the exception of one locality in the extreme southern portion of each, Sioux and O'Brien counties, and one locality in central Winnishiek County. Causes for the possible decline of Blanchard's cricket frog from north to south are being investigated.

156. Effects of developmental and growth history on timing of metamorphosis in the grey treefrog, *Hyla versicolor*

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The capacity of animals with complex life cycles to maintain plasticity in the timing of life history transitions may be subject to developmental constraints. We tested the hypothesis that the influence of recent growth history on timing of metamorphosis is limited by an ontogenetic loss in plasticity. Tadpoles of the gray treefrog *Hyla versicolor* were grown under a variety of food regimes that simulated high vs. low and changing vs. unchanging growth opportunities. In addition, the development of the tadpoles was manipulated by application of thyroxine, a metamorphic hormone. Tadpoles exposed to thyroxine metamorphosed earlier than control treatments. The interaction of growth history and thyroxine was complex. Tadpoles that were growing slowly experienced significantly increased acceleration of metamorphosis in the presence of thyroxine compared to rapidly-growing tadpoles, consistent with the antagonistic relationship that exists between growth hormones and metamorphic hormones in amphibians. While metamorphic timing was influenced by growth history in these larvae, these results support the notion that there is an ontogenetic loss of the capability of larvae to respond to an opportunity for continued growth.

157. Distinguishing the treefrogs *Hyla versicolor*/*Hyla chrysoscelis* in Iowa, and their distribution

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Historically, the tetraploid/diploid species pair of treefrogs, *Hyla versicolor*/*Hyla chrysoscelis* has been mapped collectively in Iowa. There are no distinguishing macroscopic morphological characteristics useful in recognizing the two species. This paper reports successful separation of the species by staining of nucleoli and observation of toepad projections by scanning electron microscopy. The resulting distribution correlates with call analysis mapping. A preliminary distribution of the two species in Iowa is presented showing that *H. chrysoscelis* is more-or less statewide while *H. versicolor* is limited to the southeastern half of Iowa.

POSTERS

158. Effect of feeding regime on development of food preference in newborn garter snakes (*Thamnophis sirtalis*)

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Whether the feeding preferences exhibited by animals is determined genetically, environmentally or a combination of both is an unresolved issue for most animals. I explored this question using newborn garter snakes raised on different diets. Three groups of snakes were used: those fed only tadpoles, those fed only guppies, and those fed tadpoles and guppies. I tested the feeding preferences of these newborn snakes using swabs soaked with extracts of tadpoles, guppies, tadpole/ guppy mixture, earthworm, and distilled water. Testing occurred four days after birth and every ten days afterwards for 34 days. Numbers of tongue-flicks and time to first strike at swab were recorded. Snakes fed only tadpoles developed a significant preference for the tadpole swabs over the other swabs by the second testing period, whereas snakes fed only guppies needed an additional ten days to develop a preference. Interestingly, snakes fed both food types never showed any preference for any of the swabs. No preference existed after four days. This was before any feeding occurred and suggested a lack of a genetic predisposition for any food type.

