

PROCEEDINGS

ABSTRACTS OF PAPERS, 85th Annual Meeting of the Virginia Academy of Science, May 24-26, 2007, James Madison University, Harrisonburg VA

Aeronautical and Aerospace Sciences

A TRANSPORT AIRCRAFT UTILIZING A TWO-DIMENSIONAL WING. M. Leroy Spearman, NASA-Langley Research Center, Hampton, VA 23681 & Karen Feigh, GA Inst. of Technology, Atlanta, GA 30332. The basic arrangement of conventional transport aircraft has remained essentially unchanged over the years – a central fuselage with wing panels attached to each side and tail surfaces mounted at the rear. Increased capacity has been achieved simply by increasing the overall size of the aircraft. However, such an approach may be limited for aircraft beyond the size of the current jumbo jets such as the Boeing 747. Limitations may occur in the structural requirements to support very large span cantilevered wing panels. A serious problem may occur from the trailing tip vortex, which would be much stronger than that for current transports because of the increased lift required for the larger aircraft. In an effort to alleviate such problems some research has been done with an unconventional design for a large aircraft. The design has a relatively low-span rectangular wing surface with large bodies attached to each wing tip. Using a large wing chord, the area of the rectangular wing provides adequate lift to sustain flight. The tip-mounted bodies act as end plates so there is no span-wise airflow and two-dimensional flow is provided by the wing. Since no tip flow can occur, the formation of a trailing vortex is precluded. Some wind tunnel tests have been made of such a concept. The results indicate that the concept could provide a payload capacity twice that of current jumbo jets with no increase in length, less span, and no tip vortex.

CONCEPT FOR HEAVY-LOAD SUPPLY AND SUPPORT AIRCRAFT. M. Leroy Spearman, NASA-Langley Research Center, Hampton, VA 23681 & Katie Klein, MITRE Corp., McLean, VA 22102. Airlift capability could be useful as a means of providing the logistic support of manpower, supplies and equipment in the event of natural disasters as well as in the event of warfare. The need for such support could be within the homeland area or might be at distant worldwide locations. Often, the location for such support may be inaccessible by normal means of transportation. Conventional aircraft can provide the need for speed but the load capacity may be limited and the requirement for a suitable landing area is critical. An effort to combine the requirements for capacity, speed and basing, has lead to some research relative to unconventional aircraft design concepts. One of the concepts that have been considered has a large rectangular wing surface with large bodies attached to each wing tip. The use of the two large bodies results in

essentially doubling the capacity of the conventional single-body aircraft. The large area of the wing provides adequate lift to sustain normal flight with heavy loads. In addition, if the wing should be positioned near the surface, a cushion of air would be provided that would permit operation as a wing-in-ground (WIG) effect vehicle. With judicious positioning of wing flaps and vectoring jet nozzles, vertical take-off and landing (VTOL) capability could be achieved. Thus, the inboard wing, twin-body arrangement potentially provides for large load carrying capability with a vehicle that could operate in free-air as an airplane, or near the surface in a WIG mode, or have greater basing freedom in a VTOL mode.

FROM THE EARTH TO SPACE WITH NACA/NASA. M. Leroy Spearman, NASA-Langley Research Center, Hampton, VA 23681 & Heidi Owens, Auburn University, Auburn, AL. 36849. Leonardo da Vinci envisioned man-flight in the 15th century and designed a practical airplane concept in 1490. Many other pioneers proposed various types of flying machines over the next 400 years but it was not until December 17, 1903 that the Wright Brothers, at Kitty Hawk, NC, were credited with achieving the first manned-powered flight. Over the next 100 years, several factors have influenced advances in aviation. The use of aircraft by European nations in World War I resulted in concern that the U.S. was lagging in aviation developments. This led to an act of the U.S. Congress in 1915 that established the National Advisory Committee for Aeronautics (NACA) with the charge to conduct aerodynamic research. The research began at Langley Field, VA in the early 1920's. Over the years this research has transformed low-speed, wood and fabric, propeller-driven airplanes into high speed, all-metal, jet-propelled airplanes. Jet and rocket propulsion enhanced the fields of supersonic and hypersonic aerodynamic flight and provided for access to space. In July 1955 the White House announced plans to launch an earth-orbiting satellite. Before this was done, however, the Soviet Union successfully launched Sputnik, the world's first artificial satellite in October 1957. This event caused concern that the U.S. was lagging in the 'space race' and led directly to the establishment of the National Aeronautics and Space Administration (NASA) in July 1958. The nucleus of the NASA was the existing NACA with the charge expanded to include space research. The skilled researchers at NASA-Langley have continued to provide improvements in aircraft developments and now contribute to the development of spacecraft as well. Continued advances in aerospace research require well trained researchers. To this end, NASA-Langley participates in mentorship programs to encourage high school students to become researchers. The first author of this paper has been a mentor for many years and the second author of this paper has been a student in the program. Encouragement for researchers is also provided by the VAS and the VJAS.

Agriculture, Forestry and Aquaculture Science

THE EFFECTS OF PROSTAGLANDINS ON GENES EXPRESSED IN PRE-IMPLANTATION BOVINE EMBRYOS. Titilola I. Denloye & Brian L. Sayre, Dept. of Biol., Virginia State University, Petersburg, VA 23806. Prostaglandin may have an effect on embryonic mortality. This experiment examines the relative abundance of specific mRNAs in preimplantation embryos treated with prostaglandin, employing a semiquantitative reverse transcription (RT)-polymerase chain reaction assay (PCR). Embryos were developed in vitro from bovine oocytes collected from a slaughterhouse. They were cultured with or without prostaglandin (PGE_2 and $\text{PGF}_{2\alpha}$) and/or NS 398, a specific inhibitor of PGHS-2 (n=30 embryos/treatment). Embryos (n=5/day) were collected at 24-h intervals and stored in RNALater at 20°C. Messenger RNA was harvested with Dynabeads and reverse transcribed with Superscript II enzyme. Semiquantitative PCR assays analyzed the expression of Na^+ , K^+ -ATPase $\alpha 1$ and $\beta 3$, ZO-1 α^+ , Rab13, Connexin 43. Treatments show no effect on gene expression of ZO-1 α^+ and Rab13. Increasing significant effects of treatments are shown on Connexin 43, Na^+ , K^+ -ATPase $\alpha 1$ and Na^+ , K^+ -ATPase $\beta 3$ gene expression.

CHANGES IN EXPRESSION PATTERNS IN THE EARLY CAPRINE EMBRYO DURING CRITICAL DEVELOPMENTAL STAGES. Letetia Mason & Brian L. Sayre, Dept. of Biol., Virginia State University, Petersburg, VA 23806. Blastocoele formation is critical to the development of a healthy embryo. Understanding gene activity during the critical stages of embryo development may potentially augment IVM or IVF fertilization techniques. Utilizing microarray analysis researchers will attempt to determine what genes are expressed by the embryo at each stage of development. In addition, exploring what genes are expressed in the embryo could potentially determine similarities in species. Also increase efficacy of pregnancy and potentially determine what active pathways influence embryo development. The four basic stages of embryo development 8-cell, morula, blastocyst and hatched blastocyst were studied. Estrus was synchronized and does were superovulated for collection on days 5 to 8 of pregnancy. Messenger RNA was extracted from embryos at each stage of development. cDNA was then synthesized from the extracted mRNA and then exposed to nylon micro arrays containing over 1100 genes. In the preliminary data analysis shows there is significant upregulation of genes during the earliest stages of embryonic development. Many of which are attributed to cell growth. In conclusion, further analysis will allow for definitive determination of expression patterns in caprine embryos.

STRIDUATION SOUNDS IN CHANNEL CATFISH, *ICTALURUS PUNCTATUS*, AND BLUE CATFISH, *ICTALURUS FURCATUS*. A. E. Sydnor and M. L. Fine, Dept. of Biol., Virginia Commonwealth University, Richmond, VA. Acoustic communication produced by the pectoral spines of catfish is an important component of the fishes' courtship, agonistic, and defensive behaviors. Catfish from several species have been heard to produce a stridulatory sound during these

events. With a relatively small sample size, only sounds from *Ictalurus furcatus* have been analyzed. When compared to previously-published data of *I. punctatus*, results show statistically significant interspecific variation of stridulation sounds. It can be gathered that these sounds are used in courtship behavior and evidence divergent evolution of the pattern generators of the central nervous system that signal sonic muscles.

A REPORT ON THE 2005 AQUACULTURE CENSUS FOR VIRGINIA. Scott H. Newton, Agriculture Research Station, Virginia State University, Petersburg, VA 23806. USDA Census of Aquaculture surveys conducted in 1998 and 2005 include reports on Virginia aquaculture. Also, a published analysis is available regarding the status of freshwater aquaculture in Virginia based upon surveys conducted from 1993 to 2003 by the Virginia Agricultural Statistics Service. The 2005 Report reveals declines of over 50 percent in both number of farms and acres used for aquaculture. Freshwater sales estimates for 2005 and 1998 were \$6,000,000 and \$4,900,000, respectively, (tilapia represents approximately 75% of the 2005 total). The 2005 USDA survey shows a further decline in catfish sales by over 50% since the 2003 state survey. There were no reports of live game fish sales in either survey.

SELECTION OF NATURAL ENEMIES FOR CONTROL OF INSECT PESTS OF GREENHOUSE VEGETABLES BY GROWERS WITH LIMITED ENTOMOLOGICAL KNOWLEDGE. Mark Kraemer & Françoise Favi, Agricultural Research Station, Virginia State University, Petersburg, VA 23806. Most limited-resource vegetable greenhouse growers rely on natural enemies to control insect pests. Although more costly than pesticides, biocontrol works well in the controlled environment of a greenhouse and allows growers to market their produce as “pesticide free.” However, biocontrol only works if the pests are discovered early and the correct natural enemies are selected. This requires some degree of pest identification skills. Five years of experience with greenhouse growers in Virginia and North Carolina revealed several consistent problem areas. The most important were failure to identify early signs of leaf or fruit damage, incorrect pest identification, and insufficient information provided by suppliers of natural enemies. Growers were found to have a limited ability to identify pests. Difficulties in identifying whitefly and aphid species requires that they use parasitoids with a broader host range, a mix of parasitoids, and/or predators. For decades, suppliers of natural enemies have successfully recommended a parasitoid, *Encarsia formosa*, for control of whitefly. However, in the last decade a different species of whitefly, *Bemesia tabaci*, that is not controlled by this parasitoid has become common. Growers can not tell the difference between species and risk crop loss by using this parasitoid. The “Nile” strain of *Encarsia formosa* is effective against both whiteflies and is the only parasitoid recommended.

AGRICULTURE DEVELOPMENT IN THE LIBERATED STATE OF SOUTH SUDAN. Francoise Favi & Mark Kraemer, Agricultural Research Service Virginia State University, Petersburg VA 23806. January 9th, 2005 marked the end of the longest conflict in Africa, with the signing of the Comprehensive Peace Agreement (CPA) between the Government of the Sudan and Sudan People's Liberation Movement /Army (SPLM/A) after over 30 years of civil war that left Southern Sudan with one of the lowest development indicators in the world. All policies, systems, institutional arrangements and staffing need to be built from scratch. This study aimed to organise settled refugees into cooperatives of producers and marketers. Information was obtained through written questionnaires. Data was collected from participants of training sessions on "The Organization of Farmer Cooperatives and Risk Management in Agriculture and Marketing." Participants were executive members of newly created groups of farmers from the counties of Yei, Kojekoji, Marobo and Lainya (Western Province). They produce organic food crops of sorghum (86%), groundnut (86%), cassava (100%), maize (59%) and sesame (63%). They gather mango, teak, shea nuts and coffee. Swamp areas were used from December to April to produce vegetable such as cabbage, okra, tomato, onions, eggplant, pepper and banana. Participant annual income (2005) varied from one hundred dollars US to three thousand dollars US with the later selling forest produce such as logs of teak and shea butter. Enumerated production risks are agricultural pests (96%), drought (73%) and lack of farm equipments (54%). The need for loans (86%), farm equipments (92%) and training (96%) were identified as the major constraints to agricultural production. They do not believe in pest control and fertilizer application because of health issues.

PHOSPHORUS CHEMISTRY IN JAMES RIVER SEDIMENTS. Asmare Atalay, Virginia State University, Agricultural Research Station, Petersburg, VA 23806. In aquatic systems, pH is considered to be a master variable governing the chemical behavior and distribution of several acid and base species including phosphates. The pH-dependent distribution of these species can be used to interpret solubility, complex formation, and sorption of phosphorus in such systems. Thus, using solubility equilibrium and acidity constants, we can calculate total phosphate solubility (P_T) under specified conditions (pH, calcium conc., etc). We can compute soluble P_T for pure $AlPO_4(s)$ in contact with pure water whose pH is adjusted by adding either acid or base. Similar computations can be done for $Al(OH)_3(s)$, $FePO_4(s)$, etc. The predominant phosphate species in the pH ranges of 5 and 9 are H_2PO_4 and HPO_4^- . This study attempted to evaluate the experimental conditions under which sediment-bound P can become biologically available. In a laboratory experiment, sediment samples were suspended in deionized water and equilibrated under different pH and aerobic/anaerobic conditions to assess for T, pH, Eh, carbon (C) and metal ions. Higher Al precipitation occurred at low pH, which might reflect increased stability of Al phosphates in anaerobic conditions. Alternatively, increased Al concentration at pH 7 in aerobic conditions indicated the stability of Al hydroxides as predicted by the MINTEQA2 speciation model.

MULTI-BATCHING CATFISH PRODUCTION IN VIRGINIA. David Crosby. Cooperative Extension VSU, PO Box 9081, Petersburg, VA 23806. Multi-batching catfish production project was initiated to simulate seine through water shed ponds in June of 2005. The primary goal of this project is to established seinable watershed catfish production in Southside Virginia using multi-batching production methods. Five ¼ acre ponds at Randolph Farm were stocked with catfish weighing 55 lbs. /1000 fish in June of 2005. The ponds were restocked with 375 fish each in March of 2006. These fish weigh about 35 lbs. per 1000 fish. Catfish were stocked at 5000 fish per acre in 2005. Catfish were fed to satiation five days per week. An off site demonstration pond in Lunenburg county was established in conjunction with this project. The 0.67-acre demonstration pond was stocked with 6100 fish at 52 lbs. per 1000 fish. Three of the five ponds at Randolph Farm were harvested in October of 2006. This resulted in 692 lbs of fish weighing an average of 1.58 lbs each or equivalent to 923 lbs per acre. The demonstration pond produced 1375 lbs in June 2006. This is equivalent to 2063 lbs. per acre. These fish had an averaged weight of 1.7 lbs. each at harvest. The demonstration pond received 4 tons of feed before harvest. The preliminary results indicate that multi-batch catfish production is possible in Virginia.

ANTHELMINTIC RESISTANCE AND ALTERNATIVE MANAGEMENT STRATEGIES FOR SMALL RUMINANTS. Joseph P Tritschler, Michaela PL Dismann, & Brian L Sayre, VA Coop Ext, VSU, Vet Sci, Chesterfield Tech Center, & Dept Biol, VSU. In 2003, a survey of anthelmintic use and resistance was conducted of small ruminant producers throughout Virginia. On-farm anthelmintic efficacy was evaluated for anthelmintic products of all three classes using Fecal Egg Count Reduction (FECR%) testing. Both, fenbendazole and ivermectin resistances were severe to moderate resistance at 2 to 3 times recommended dose (RD), respectively. Levamisole was generally effective at 1.5-2.0 RD. Moxidectin, a newer and stronger macrocyclic lactone, was generally efficacious. As a follow-up, moxidectin was retested in 2007, and resistance was severe at 1 to 3 times RD. Generally, FEC indicated no reduction following treatment at any time or dose, and FEC increased in spite of treatment with moxidectin. Overall management did not favor strategies that theoretically would increase selection pressure for resistance. Moxidectin resistance probably developed from the existing ivermectin resistance. The authors gratefully acknowledge the help of the Veterinary Science program at Chesterfield Technical Center. As part of this work, students were trained in FAMACHA, fecal analysis and animal management, enabling this collaborative learning, outreach and research between local farms, veterinarians, Cooperative Extension and the Chesterfield Public School System. This work was partly funded by SARE.

IDENTIFICATION OF SINGLE NUCLEOTIDE POLYMORPHISMS IN GENES MAPPED TO THE VIRTUAL GOAT GENOME MAP. Brian L. Sayre, Dept. of Biol., Virginia State University, Petersburg, VA 23806. It has become necessary to search for a new method of parasite control in goats. Our approach is use a

combination of quantitative trait loci (QTL) mapping and microarray analysis to identify genes associated with parasite resistance. Currently, a genetic linkage map and a virtual genomic map are available for goats. The objective of this project was to increase the genomic information in the goat with identification of single nucleotide polymorphisms (SNPs). A cDNA library was developed and EST sequences generated from the library. The EST sequences were assembled and clustered with the Paracel Transcript Assembler. The clustered sequences were aligned to develop a consensus contig used for identification. The aligned sequences were visually analyzed for SNPs using the BioEdit sequence analysis program. SNPs were defined as nucleotide differences in aligned sequences that were found in at least two sequences. The mean frequency of SNP sequences was 28%, with a mean frequency of 0.4% SNPs/sequence. The frequency of SNPs within the sequence was quite variable ranging from 0 – 4.6%. Additionally, alternative splicing sites were located in the analysis of several genes. These SNPs are important to producers because they potentially relate to changes in the proteins that are produced. The changes in the proteins can lead to altered phenotypes that may be important for production. Likewise, SNP markers are generally more informative than microsatellite markers which will allow for more extensive genetic analyses of goats. The identification of markers related to specific phenotypes can be used by producers for marker-assisted selection.

UPDATED COMPARATIVE ANALYSIS FOR DEVELOPMENT OF A VIRTUAL GOAT GENOME MAP. Brian Sayre, Dept. of Biol., Virginia State University, Petersburg, VA 23806. The goat is an important species worldwide and is the basis of a rapidly growing industry within the U.S. Goats are highly adaptable and survive in virtually all parts of the world. A better understanding of the goat genome could allow for new discoveries from the genetic diversity and adaptations important to ruminant health and production. Currently, very little is known about the goat genome; however, a genetic linkage map is available. Connections between the bovine, sheep, human, and the goat map have been made previously. The similarity between the goat and cattle genomes and recent sequencing of the bovine genome provides an opportunity for comparative genomics to be used to predict the location of genes in the goat. We have sequenced over 12,000 goat ESTs resulting in 6,354 unique sequences of which 3,175 were identified by BLASTx analysis. Comparative mapping among the goat, cattle, and human maps were used to predict the location of the ESTs in the goat genome and update a previous version of the virtual goat map. The identified genes were placed by first identifying the location in the bovine or human map. Then prediction of EST locations was determined through comparisons of the goat map and the bovine and human maps. The predicted map, or virtual goat genome, will be useful for the determination of EST and microsatellite markers during development of a goat RH map.

**Astronomy, Mathematics and Physics
&
Materials Science**

A GENERAL RELATIVISTIC MODEL FOR THE ELECTRON. Joseph D. Rudmin, James Madison University. Electron fields are described using Parker Sochacki expansions to solve the Einstein equation. Properties of the expansions and the differential equations which generate them suggest why the gravitational constant is so small. The calculations are done using an isotropic metric. Such a metric yields an Einstein tensor $G^{\mu\nu}$, for which the mass density, $G^{44} = -g^2(2\nabla^2 V_G + (\nabla V_G)^2)$, has distinct terms for ordinary matter and gravitational fields. The equations which advance each series are Sturm-Liouville equations, for which one can obtain exact azimuthal expressions at each order.

EDDY CURRENTS IN ALUMINUM V-TRACKS. D. Rae Carpenter, Jr. (Ret), Richard B. Minnix, G. Mercer Brooke, IV, Virginia Military Institute, Lexington, VA 24450. Neodymium magnets are now available in spherical shape¹ and appear outwardly identical to steel ball bearings, each 3/4" diameter. Aluminum angle is readily available in home improvement stores in two or more thicknesses for installation as edging on wood tables. Lenz' Law says induced currents are in such a direction as to oppose the change that caused them. This is a recipe for a great demo showing Lenz' Law in eddy current braking. More specifically, the aluminum angle is 45" long, 3/4" wide and in thicknesses of 1/16" and 1/8". Incline the angle at convenient values of 30, 45, and 60 degrees and compare the velocity of the steel bearing with the Nd sphere as objects rolling down an inclined plane. The effect of the eddy current is pronounced when allowing the Nd magnet to roll down first on the 1/16" thick track and then the 1/8" thick track. The effect of this thicker wall reminds one of the cow magnet demo in which cow magnets are allowed to fall vertically inside cylindrical pipe of plastic, brass, aluminum, and copper of various diameters and wall thicknesses.² The advantage with the V-track is total visibility. Theory for the pipe shows that the fall time depends on wall thickness, conductivity, magnetic moment squared and inversely on magnet weight and the fourth power of tube radius.³ For this Fe/Al/Nd demo the theory is a bit more complicated because the containing "wall" is a right angle V-track. This is "left to the serious student."

GROWTH OF SINGLE-WALL CARBON NANOTUBES FROM NANOCRYSTALLINE MAGHEMITE. Jake Bennett & Dr. Rama Balasubramanian, Dept. of Physics, Roanoke College, Salem VA 24153. Growth of single-walled carbon nanotubes (SWNT) in specific configurations is very important for applications in nanoelectronics. This project focused on growth of SWNTs from novel catalysts, specifically nanocrystals of maghemite (γ -Fe₂O₃), for fabrication of sensor devices. The maghemite nanocatalyst for SWNT growth was obtained by dehydroxylating lepidocrocite (γ -FeOOH). Lepidocrocite was synthesized by neutralizing ferrous chloride solution with NaOH. Infrared and Mössbauer

spectroscopy results confirmed the growth of maghemite nanocrystals from lepidocrocite. SWNTs were then grown using maghemite nanocatalysts deposited on a (100) Si wafer by CVD. The growth of SWNTs was confirmed from AFM and SEM imaging. The average diameter of the nanotubes was measured to be about 2 nm. Detailed analysis of the morphology of the maghemite nanocatalyst and SWNT growth will be presented.

AN UNORTHODOX ANALYSIS OF THE CASSINI-HUYGENS PHOTOS OF TITAN. Joseph W. Rudmin, Dept. of Physics & Astron., James Madison Univ., Harrisonburg, VA 22807. The webpage <http://antwrp.gsfc.nasa.gov/apod/ap050119.html>, the NASA Astronomy Picture of the Day, purports to be a collage of photos taken by the Huygens Lander as it descended from the Cassini Spacecraft to the surface of the Saturn's moon Titan in Dec 2004. If this photo is reflected left-to-right the resulting picture bears a striking resemblance to Pearl Harbor showing events which happened on Dec 7, 1941. In particular are eight-ship-shaped objects which appear to be emitting two smoke plumes. This part of the collage duplicates a portion of the picture immediately to its left. When the duplication is eliminated, the scene subjectively appears to be aerial photos of battleship row taken during the Japanese attack. Identifiable in the picture are eight battleships, the cruisers Oglala and Helena and the dock to which they were moored, the runway on Ford Island, hangers along the runway, and the streets of Pearl City in the background. A webpage of the analysis, which was sent to JPL and the European Space Agency, is available at <http://csma31.csm.jmu.edu/physics/rudmin/titan/titan.htm>.

TRANSFORMATIONS OF SPECIFIC CONVEX POLYGONS INTO OTHER POLYGONS. I. H. Tomlin, Clover Hill High School., Clover Hill High School, 13900 Hull Street Road, Midlothian, VA 23112. Many people are familiar with transformations such as rotation, translation, reflection and dilation. This article addresses a new transformation, concerning certain polygons being transformed into others. For this transformation to take place, there must be a convex polygon with an even number of sides in which the opposite sides and angles must be equal. The transformation, geometrically speaking, involves the creation of a line between two opposite angles of a polygon, and the aforementioned line's perpendicular bisector. Then, one-half of the polygon, as dictated by the line between the angles, is reflected across the perpendicular bisector. This can most easily be applied to parallelograms, which fit the requirements perfectly, and with which is first described and modeled. Next, the transformation is applied to other shapes that fit the operator's requirements. When the transformation is performed, the shape ends up creating kite- or deltoid-like shapes. The mathematics behind these transformations is explained.

A PRECISION MEASUREMENT OF THE MUON LIFETIME AND THE DETERMINATION OF THE WEAK COUPLING CONSTANT G_F . Kevin L. Giovanetti, & MuLan Collaboration, Dept. of Physics, James Madison University, Harrisonburg VA 22801. A new measurement of the muon lifetime, τ_μ , at the 11 ppm level will be reported. This is the first result from the MuLan experiment, which is pursuing the ambitious goal of a 1ppm determination of the muon lifetime--a 20-fold improvement. The experiment is motivated by recent theoretical improvements in extracting the Fermi coupling constant, G_F from the measured lifetime; the theoretical uncertainty is now less than 1 ppm. The coupling constant, G_F is an essential parameter of the standard model and represents the strength of the weak interaction. Progress, highlights and future plans for this experiment will also be discussed.

SOFTWARE DEVELOPMENT FOR THE JMU MINERVA PHOTOMULTIPLIER TUBE ALIGNMENT STAND. Erik C. van der Goetz, Dept. of Physics and Astron., James Madison Univ., Harrisonburg VA, 22807. An overview of a computer program written in the language IDL designed to measure misalignment of photomultiplier tubes to be used in the MINERvA project conducted at Fermi National Accelerator Laboratory. The program takes in high-resolution pictures of the photomultiplier tube with an alignment gage suspended across, and then measures how far misaligned the sides of the photomultiplier tube is to the gage by image processing and analysis. Such a program is necessary due to the number of photomultiplier tubes that must be aligned, as well as the low level of error tolerance that must be achieved.

OBSERVATIONS OF BLAZARS AND POLARS WITH SMALL TELESCOPES. M. Wilkins, T. Kelley, R. Perrino and W. Alexander. Department of Physics and Astronomy. James Madison University, Harrisonburg, VA, 22801. Blazars are variable active galactic nuclei (AGN) that are oriented in such a way that we observe them looking directly into one of its jets. Blazars are new objects astronomers are observing, having only been discovered in the late 1970's. The first Blazars were detected in the constellation Lacerta and are called BL Lacerta objects. Missions such as the GLAST and SWIFT missions through the National Aeronautics and Space Administration (NASA) will be studying these objects in more detail in the coming years. During the Spring 2007 semester, our research group took data and determined the magnitude of certain Blazars and Polars that are visible in the mid-winter sky. However, we made sure that our equipment would be able to detect these objects at the dimmest time of their variability

Biology

EFFECTS OF A NOVEL *CIS*-TERPENONE ON CYTOKINE PRODUCTION BY RAW 264.7 MACROPHAGES. S. Kabir, Q. Zhou & J. K. Stewart, Department of Biology, Virginia Commonwealth University, Richmond, VA 23284-2012. Terpenes previously were shown to reduce tumor cell growth, and one terpene has been reported to decrease immune responses. A novel *cis*-terpenone, 3-hydroxy-*cis*-diterpene (HCD), was synthesized and tested for effects on macrophage production of cytokines. RAW264.7 macrophages were cultured in RPMI 1640 supplemented with 10% FBS, standard nutrients and antibiotics. Cells were plated in 24 well plates (0.75 million cells/well) and permitted to adhere in growth medium overnight. The cells were stimulated with 30 ng/mL LPS in serum free media containing vehicle or various concentrations (10, 20 or 40 mM) of HCD. Extracellular medium was collected 4 h after treatment for measurement of TNF- α and 24 h after treatment for measurement of IL-1 β and IL-6. HCD promoted a concentration-dependent decrease in LPS-stimulated production of TNF- α at 4 h and IL-6 and IL-1 β at 24 h in RAW264.7 macrophages. (Supported by NSF grant MCB 0131419 and Jeffress Memorial Trust grant J-849)

EFFECTS OF INJECTED ASCORBIC ACID (VITAMIN C) ON FREQUENCY OF LIPOPOLYSACCHARIDE-INDUCED PREGNANCY LOSS IN CD-1 MICE. John Shilan¹, David Coppola¹, Carolyn M. Conway², & Arthur F. Conway¹, ¹Dept. of Biology, Randolph-Macon Coll., Ashland, VA 23005 and ²Dept. of Biology, Virginia Commonwealth Univ., Richmond, VA 23284. Lipopolysaccharides (LPS) cause strong inflammatory responses and can cause pregnancy loss at low doses. We studied the effects of intraperitoneal and subcutaneous administration of ascorbic acid on frequency of LPS-induced pregnancy loss. Intravenous injection of two micrograms of LPS on day 9 of gestation significantly increased frequency of pregnancy loss, decreased weight of implantation sites, and caused significant maternal weight loss. Intraperitoneal or subcutaneous injection of 15 milligrams of ascorbic acid 45 minutes prior to the LPS injection failed to inhibit LPS-induced pregnancy loss or increase implantation site weights, but inhibited maternal weight loss. Subcutaneous injection was more effective than intraperitoneal injection of ascorbic acid, but we are unsure of the reasons.

SEASONAL VARIATION IN DIET OF THE HISPID COTTON RAT, BASED ON FECAL ANALYSIS. L. A. Walker & R. K. Rose, Dept. of Biol. Sciences, Old Dominion Univ., Norfolk, Virginia 23529-0266. Cotton rats live in oldfields, habitats with a variety of mostly herbaceous plants. The hispid cotton rat, *Sigmodon hispidus*, eats predominantly grasses but grasses are rarely the only food. My study determined the diet of the cotton rat in eastern Virginia, at its northern limit of distribution on the Atlantic Coast. Fecal samples were collected each month during an on-going capture-mark-release demographic study of the rodent community at a location in southern Chesapeake. Five fecal pellets per animal were stained with a mixture lactophenol blue stain, washed in distilled water three times, ground in

water with a mortar and pestle, and then a drop-sized aliquot was placed onto a microscope slide. The water-plant material mixture was spread onto the middle third of the microscope slide and allowed to dry on a warming plate. After a starch-gel medium and a coverslip were applied, the coverslip was ringed with clear nail polish to produce a semi-permanent slide. Plant species were identified by their unique micro-anatomical features, including epidermal hairs, trichomes, and stomates. Two slides were prepared for each animal, and on each slide 25 microscope fields were examined. A greater variety of foods (including insects) was eaten in the summer and autumn, when food was most abundant and varied. In winter, when much herbaceous vegetation was dead, cotton rats supplemented their diets with pine bark. Cotton rats ate greater amounts of monocots in winter and spring, an apparent response to the need for more calories to compensate for greater heat loss. In summer and autumn, cotton rats enhanced their diets to include greater proportions of the more nutritious but harder to digest dicots.

BODY WEIGHT DYNAMICS AND SEXUAL DIMORPHISM OF MEADOW VOLES IN EASTERN VIRGINIA. S. E. Bell & R. K. Rose, Department of Biological Sciences, Old Dominion University, Norfolk, Virginia 23529-0266. From December 2002-March 2005, we did a capture-mark-release study on a Chesapeake, Virginia population of meadow voles (*Microtus pennsylvanicus*). The study site was a 1 hectare grid in an old field dominated by little bluestem, goldenrods, asters, wool grass, and pines. We put two modified live Fitch-type traps at 12.5 m intervals and trapped on the grid in monthly three-day sessions. Individuals were ear-tagged and their sex, weight, and reproductive condition recorded. Unlike other studies in northern North America, where the voles experience autumn and winter weight loss, individual meadow voles on our site continued to gain weight throughout the winter. On average, the adult voles weighed 45-70 g and several weighed 80-90 g. The heaviest individual voles were present in late autumn and winter. The autumn-born voles at our site had no delays in growth or reproduction and breeding occurred year-round. The meadow voles had an average lifespan of 17-weeks, similar to other reports; however, notably long-lived individuals included a male of 69 weeks and a female of 52 weeks.

ORIENTATION OF PRAYING MANTID EGG CASES IN A PINE-DOMINATED OLD FIELD. R. K. Rose & A. S. Bellows, Department of Biological Sciences, Old Dominion University, Norfolk, Virginia 23529-0266. In 2005, we collected information on the placement on vegetation of the egg cases of the Chinese praying mantis, which were abundant in our old field that was becoming dominated by loblolly pines. We recorded the type of vegetation holding the egg case, its height from the surface, and the approximate compass orientation of each egg case. Of 421 egg cases, ca. 400 were placed from 0.3 – 3.5 m in woody plants and their compass orientation was non-random. The greatest number was oriented southward, suggesting an adaptive advantage such as earlier hatching due to slightly higher temperatures during development. To test this hypothesis, in 2006 we collected 163 egg cases (after recording similar information for each,

including accurate compass readings) and returned them to the lab, placing each egg case into a 1-qt mason jar. As the hatchlings emerged, information on their numbers and days to hatching was collected. ANOVA revealed no differences in the numbers of hatchlings from the 8 compass directions. However, because once again in 2006 the egg cases were strongly oriented in the southerly quadrant, >50% of hatchlings came from egg cases facing SE, South, or SW. In 2007, we found 149 egg cases in late winter, and after recording the same information as before (with compass), we learned that south-facing locations again dominated, seemingly a consistent pattern. In each year, ca. 90% of egg cases were placed at 0.9 – 2.4 m heights, mostly in sweet gum and pine trees, the most common woody plants on the site.

THE ULTRASTRUCTURAL EFFECTS OF EPIDERMAL GROWTH FACTOR ON LIVER REGENERATION IN RATS. Krista M. Edelman & Kathryn E. Loesser-Casey, Dept. of Biol., Univ. of Mary Washington, Fredericksburg VA 22407. Liver disease and liver failure are serious health problems today and scientists are constantly striving to discover exactly how the liver is able to regenerate so significantly after injury. This regenerative capacity has been studied in a variety of animals, especially following the partial hepatectomy (PHx) of rats where within two weeks, the original size of the organ is restored. A complex array of growth factors interacts to allow this regeneration. One notable growth factor, Epidermal Growth Factor (EGF), is considered a mitogen as it is capable of stimulating hepatocytes in culture to undergo DNA synthesis. In this study, we investigated the effect of administering daily subcutaneous injections of EGF to rats following PHx surgery in hopes of better understanding the role that EGF plays in liver regeneration. Ultimately, we found that the administration of EGF caused a statistically significant increase in the ratio of the rat liver to body of the rats that underwent PHx surgeries, but not in the rats that underwent sham surgeries. Additionally, the rats that received EGF gained substantially more weight in the two-week time period between surgery and sacrifice than those that did not receive the growth factor. Additionally, various organelles were seen in the liver tissue especially rough endoplasmic reticulum, in the rats that underwent PHx surgeries. In conclusion, this research suggests that EGF has significant effects on both rat liver to body weight ratios and also on the amount of weight that rats gain, but there are still many other questions about the liver regeneration process that have yet to be answered.

MONOCARBOXYLATE TRANSPORT PROTEIN CHANGES IN SHHF RATS. Julia M. Rothlisberger & Kathryn E. Loesser-Casey, Dept. of Biol., Univ. of Mary Washington, Fredericksburg VA 22407. The heart is comprised of tissue that utilizes fatty acid oxidation for its main ATP source. However, glucose oxidation is more efficient if the ATP generated per oxygen molecule in each process is compared. During heart failure the myocardial tissue increases its more fetal form of energy production, glucose or lactate oxidation and decreases its fatty acid oxidation. Monocarboxylate Transporter 1 (MCT1) is responsible for the lactate influx to the cardiac myocytes. The Spontaneously Hypertensive Heart Failure

(SHHF) rat has emerged as a major research tool for heart failure studies. One aspect of research that has not yet been conducted on SHHF rats is the synthesis, production, and distribution of the MCT1 protein. The specific goal of this research project was to determine if there was an up regulation of MCT1 in SHHF rats that showed symptoms of heart failure. SHHF rats of 4 months and Sprague-Dawley rats of 7 months were sacrificed. A marked increase in MCT1 protein concentration was observed in the SHHF rat when compared to the control Sprague-Dawley rat following Western Blotting. The heart samples were also observed under a Transmission Electron Microscope. SHHF myocytes showed signs of heart failure: disintegrated mitochondria along with degeneration of contractile fibers and pyknotic nuclei. Further research needs to be done in order to obtain more information about the SHHF rat and how it can help heart failure patients. Knowing more about the SHHF rat and its specific characteristics may help scientists develop new treatments for heart failure and safely test them of the SHHF rat.

THE AFFECTS OF THIAZOLIDINEDIONES ON THE MYOCARDIAL CELLS OF KK-A^y MICE. John Ha & Kathryn E. Loesser-Casey, Dept. of Biol., Univ. of Mary Washington, Fredericksburg VA 22407. Type II diabetes can be characterized by non-responsiveness of cells to adequate amounts of insulin. One adverse effect of diabetes is pericyte degeneration, which results in the inability to regulate the influx and efflux of substances out of the capillaries. Another effect is the thickening of the basal laminar layer in myocardial capillaries, which limits diffusion across the endothelial cells of capillaries. To help limit these and other problems associated with diabetes, drugs commonly known as glitazones are used. This study sought to examine the ultrastructural changes in a model of diabetic mice known as KK-A^y strain. Eight mice were fed mouse chow with no additives while another eight mice were given 3mg/kg of glitazones with their regular chow. The ultrastructure of the left ventricle was observed after 20 weeks of treatment. There appeared to be a positive correlation of pericyte degeneration and thickening of capillary membranes in KK-A^y mice in the microscope. However, when these membranes were measured using Image J software and the results analyzed using a Student's T-test, there was no statistical difference between the groups ($p=0.58$). However, the average weight gain and the presence of adipose tissues, were found to be higher in the experimental groups than in the control groups. The more obvious presence of fat tissues in the experimental group may account for the significantly greater weight gain. Further research on this topic should be conducted in order to confirm the results and to better understand the health of pericytes and capillary membranes in diabetics. This may help create methods for effectively treating diabetes in the near future.

THE IMPACTS OF URBANIZING LANDSCAPES ON AVIAN DIVERSITY IN THE MID-ATLANTIC COASTAL PLAIN: THE ROLE OF AVIAN DIETARY GUILD. Elise A. Larsen, Dept. of Biol., College of William and Mary 23187 & Bryan D. Watts, Center for Conservation Biol., College of William and Mary, Williamsburg, VA 23187-8795. Many migratory bird species are declining in

abundance. Habitat loss and fragmentation due to urban development are considered main causes of these declines, and diversity of bird species generally declines with urban development. However, not all bird species respond similarly. Our research explored how bird species respond differently to urban development, depending on their food resources. We studied the relationship between bird diversity and urban sprawl using spatial analyses. We used the U.S. Geological Survey's National Land Cover Dataset to estimate urban development based on the percent of the land covered by impervious surface within 300 meters of each site. Bird diversity for different dietary groups was determined from North American Breeding Bird Survey counts collected in 2000 and 2001. Our initial findings indicated that breeding diversity responded differently to urbanization according to the birds' food resources. Insect-eating birds responded most negatively to urban development, while birds with flexible diets responded most positively. These results suggest that food resources are changing with urbanization, with naturally occurring food resources becoming limiting resources for some bird populations, and anthropogenic food resources augmenting others. In order to understand how continued urban development will affect bird populations and related conservation efforts, future research must examine urbanization impacts in terms of food webs and community interactions.

THE ENCAPSULATION OF PHYSIOLOGICAL SOLUTIONS INTO CELL-SIZE LIPOSOMES. Mahvash Mujahid, Kathryn Loesser-Casey, & Stephen Gallik, Dept. of Biol. Sci., Univ. of Mary Washington, Fredericksburg, VA 22401. Liposomes are spherical vesicles of varying diameter bound by one or more membrane bilayers. The internal compartment of the liposomes commonly contains an aqueous solution, the composition of which varies based on the method of production. The focus of this project is to generate cell-sized liposomes (5 – 50 μm in diameter) encapsulating a physiological phosphate-buffered saline (PBS) solution (145 mM, pH 7.4) and to assess the construction of these vesicles based on two parameters: liposome diameter and yield. Liposomes were generated using a simple, rapid evaporation procedure in which phosphatidylcholine, a major biomembrane lipid, chloroform, methanol, and an aqueous solution (deionized water or 145 mM PBS) were added to a round bottom flask and subsequently placed in a rotary vacuum evaporator to remove the organic phase. Samples from each product were digitally photographed using light microscopy, scanning electron microscopy, and transmission electron microscopy. The data from the images were analyzed using Image J. Light and electron microscopy data analysis reveals that the liposomes produced in deionized water had diameters ranging from approximately 0.71 μm to 95.51 μm , and those produced in the 145 mM PBS solution had diameters approximately 0.0036 μm to 76.97 μm . Large quantities of vesicles were produced in both deionized water and in the 145 mM PBS solution, approximately 3.52×10^7 vesicles/mL of deionized water and 5.77×10^7 vesicles/mL of 145 mM PBS. This project reports the first successful production of cell-sized unilamellar liposomes encapsulating a physiological salt solution.

INFLUENCE OF RETINOIDS AND ETHANOL ON EMBRYONIC CHICK INTESTINAL DEVELOPMENT. J. Orion Rogers, Ashley DeFreitas & Ashlee Carter, Dept. of Biol., Radford Univ., Radford VA 24142. Literature surveys reveal that retinoic acid (RA), a derivative of vitamin A, affects vertebrate developmental processes and that ethanol (EtOH) retards embryonic growth. The objectives of this project were to determine the effects of EtOH and RA on the differentiation of intestinal epithelium from 14-day-old chicken embryos incubated for 48 hours at 38 °C in culture medium 199 containing solvent controls, 0.5% EtOH, 10^{-7} or 10^{-8} M RA, and combinations of EtOH and RA. The hypotheses tested were that RA will increase and EtOH will decrease goblet cell numbers along previllous ridges compared to solvent controls. After incubation, tissue was fixed in Carnoy's fixative, dehydrated in 100% EtOH, cleared with HemoDe, and embedded in paraffin. Ribbons of 5 mm thick sections were cut, and goblet cells were stained by the periodic acid-Schiff (PAS) procedure with fast green as a counterstain. Both goblet cell number and previllous ridge height increased significantly from 14 to 16 days in uncultured tissue. Total goblet cell numbers and the percentage of goblet cells in the distal half of the previllous ridge were significantly decreased by 0.5% EtOH ($p < 0.05$) and 10^{-7} M RA ($p < 0.025$) compared to solvent controls. Previllous ridge height was significantly increased in the presence of 10^{-7} M ($p < 0.025$) and 10^{-8} M ($p < 0.05$) RA compared to solvent controls. These results imply a role for RA in the differentiation of cultured duodenal epithelium of embryonic chicks.

A PHYLOGENY OF THE SNAPPERS (LUTJANIDAE; PERCOIDEI) INFERRED FROM CYTOCHROME B SEQUENCE DATA. Matthew R. Semcheski & Kent E. Carpenter, Department of Biological Sciences, Old Dominion University, Norfolk, VA 23529. The Lutjanidae are the economically and ecologically important fishes commonly known as snappers. Early studies of Lutjanidae concluded that it contained four subfamilies. Together with the family Caesionidae, the lutjanids formed the Superfamily Lutjanoidea. Although this view was supported elsewhere in the literature, it was later contradicted, treating the caesionids as members of the Lutjanidae. Further investigations revealed complications within the subfamily Lutjaninae. In order to infer a phylogeny of genera within Lutjanidae, the complete cytochrome b gene (1140bp) of 22 lutjanid taxa was sequenced and analyzed along with 20 sequences obtained from GenBank. Analyses included base composition, saturation analysis, maximum parsimony (MP), and maximum likelihood (ML). Base composition remained stationary throughout the entire data set. Substitutions increased linearly with sequence divergence. MP analysis failed to resolve relationships at the subfamily level. ML analysis resolved a monophyletic Lutjanidae as well as monophyletic subfamilies within Lutjanidae. Both MP and ML grouped the caesionids within the subfamily Lutjaninae, most closely related to *Macolor niger*. Results illustrate a close relationship between caesionid and lutjanid taxa. However, the placement of caesionids in the Lutjanidae remains unresolved as they fall out within Lutjaninae, rather than a separate subfamily, with *Macolor niger* being a transitional species between Lutjaninae and Caesioninae. Relationships

among genera within Lutjaninae remain unresolved, with the genus *Lutjanus* paraphyletic.

DETERMINING AN ASSOCIATION BETWEEN OCULAR DOMINANCE AND HANDEDNESS. Daniel R. Swale & Harold Grau. Department of Biology, Chemistry, & Environmental Science, Christopher Newport University, Newport News, Virginia. Associations between ocular dominance ("eyedness": the tendency to prefer visual input from one eye to the other) and handedness have been recorded in children (10-15 Y.O.A.) but not in adults (30-60 Y.O.A.). Our study compares the relationship between ocular dominance and handedness in ages 16-24 Y.O.A. with use of the Dolman Method. Our results show that approximately 65% of the subjects tested (n = 200) had an ipsilateral handedness/ocular dominance association, with a Chi-square (χ^2) of 22.7, $p < .001$. Right-handed subjects showed a statistically significant result between handedness and ocular dominance ($\chi^2 = 17.5$, $p < .001$) while left handed individuals had a non-significant result.

CAN NEUROTROPHIC FACTORS PROTECT NEURONS IN THE SUBSTANTIA NIGRA FROM DEGENERATION BY MPTP? L. A. Viscome & D.A. O'Dell, Dept. of Biology, University of Mary Washington Parkinsons' disease (PD) is believed to result from the progressive loss of dopaminergic neurons in the substantia nigra (SN) of the brain. Neural degeneration in the SN has visible effects; PD is usually associated with symptoms such as a tremor and bradykinesia. The chemical MPTP causes similar clinical symptoms when injected into experimental animals because of its selective destruction of SN cells. In this research project, we tested whether neurturin, a common neuroprotective neurotrophic factor, could interrupt the apoptotic process initiated by MPTP in cell cultures. We compared three control groups with a single treatment group (cells treated with both MPTP and neurturin). Through a paired two sample t-test it was determined that the experimental group showed a significant increase in the rate of cell survival compared to cells treated with MPTP alone. Although the rate of apoptosis was increased compared to both untreated cells and cells treated with neurturin alone, there was no significant difference. Thus, neurturin can protect cells in the substantia nigra from MPTP mediated apoptosis.

Biomedical and General Engineering

DESIGN AND TEST OF A HEAT PUMP WATER HEATER. Lam D. Vu, Kevin P. Yost, Robert J. Landes, and Tony D. Chen, Department of Integrated Science and Technology, James Madison University, Harrisonburg, VA 22807. A nominal 29,000 Btu/hr Lennox Elite[®] Series HS 29 air-to-air heat pump was converted into a heat pump water heater (HPWH); the performance of such a system was tested in the lab using an Omega[®] thermocouple interface card and LabView[™] software to examine the temperature change and difference throughout the system. Five

thermocouples were placed in the 80-gallon water tank to investigate the water temperature stratification, and two thermocouples were placed on the suction and discharge side of the compressor. Air temperature in and out of the evaporator, water flow rate, and total electric power consumption were also monitored throughout the test. Single-cycle data were collected for calculating the coefficient of performance (COP) of the system. The preliminary result shows that the COP is 0.68 ± 0.02 for Add-on and 1.19 ± 0.01 for Drop-in configuration: both cases with no proper insulation around the vessel and copper tubing and less than an ideal amount of refrigerant R-22 in the system. A feasibility model of the current heat pump water heater was developed to examine the pros and cons of running this kind of HPWH system in a residential or commercial setting.

VALIDATION OF A COMPUTATIONAL MUSCULOSKELETAL MODEL OF THE ELBOW. Justin P Fisk and Jennifer S Wayne, Departments of Biomedical Engineering and Orthopedic Surgery, Virginia Commonwealth University, 701 West Grace St, Richmond , VA 23284. Musculoskeletal computational modeling can be a powerful and useful tool to study joint behavior, examine muscle and ligament function, measure joint contact pressures, simulate injury, and analyze the biomechanical results of reconstructive procedures. While many musculoskeletal models of the elbow have been developed, all have constrained the articulations to have particular degrees of freedom and ignored the effects of ligaments. This work develops and validates an accurate computational model of the elbow whereby joint behavior is dictated by three-dimensional bony geometry contact, ligamentous constraints, and muscle loading. Bony geometry was extracted from CT scans and ligaments were represented as linear, tension-only springs. The model was implemented through use of a rigid body dynamics simulator, capable of detecting contact between bodies and applying appropriate reaction forces. For validation purposes, a set of tests equivalent to a published cadaver study were performed. Preliminary model results indicated good agreement with published experimental findings, but additional testing is underway to further demonstrate model accuracy.

EFFICIENCY EVALUATION OF A MULTIPLE DISK CENTRIFUGAL BLOOD PUMP. Alissa K Wong & Gerald E Miller, Department of Biomedical Engineering, Virginia Commonwealth University, Richmond VA 23284-3067. It has long been debated if continuous flow can support the human circulation for long periods of time. Continuous flow rotary pumps are the basis for most current designs of Left Ventricular Assist Devices (LVADs), due to their small size and lack of valves. However, positive displacement pumps have been more successfully used as long-term LVADs, due to their pulsatile nature. The current study is focused on modifying a continuous flow multiple disk centrifugal pump (MDCP) into a pulsatile pump, to allow for the combined benefits of the pulsatility from positive displacement pumps and the small size and valveless design of rotary pumps. An efficiency study was carried out by evaluating the hydraulic work output and the input power requirements of the pump; the pump was evaluated in both continuous and pulsatile modes. In continuous mode, the pump was able to maintain a flow of

5.5L/min at 1155rpm. Other centrifugal LVADs have reported rotational speeds around 2400rpm to produce flows around 5L/min. The lower rotational speeds of the MDCP indicate lower shear stress applied to the blood cells, resulting in a reduced risk of hemolysis. Also, the lower speeds will lessen the mechanical wear of the moving parts within the pump, thus potentially increasing the device's lifespan. In pulsatile mode, cardiac outputs of 5L/min were achieved against a 55/27mmHg afterload. Efficiencies found in pulsatile mode ranged from 3-18%, with 0.5-2.3W power consumptions. It is thought that increasing the input voltage will allow the pump to produce large flows against larger, more physiologic, pressure heads while still maintaining relatively low power requirements.

A GAZE-BASED HUMAN COMPUTER INTERFACE. Federico Puma, Dept. of Biomedical Engineering, VCU. A method for a real-time communication system is presented. The system uses the individual's gaze to control cursor movement over a computer screen. The creation of an innovative algorithm, allows an efficient and accurate determination of gaze position. This algorithm combines eye position data and head position data in real-time to output the direction of the user's line of sight. Eye movements are measured with a pupil-corneal reflection device and head movements are measured with a magnetic tracking system. Another important feature of the interface is the ability to detect and classify the user's eye blinks in order to provide input to the computer similar to common mouse clicks. Voluntary blinks are used to trigger mouse clicks and therefore, enable interaction. The presence of a voluntary eye-blink is declared when the duration of a blink event surpasses an experimental prefixed time value. The system is intended to provide an alternative input modality for human computer interaction systems. Preliminary tests and results prove that the system is useful for individuals whose only channel of interaction is through their eye movements or individuals that, for any reason, are unable to use their hands to control cursor movement.

READING EYE MOVEMENTS AND PARKINSON'S DISEASE. P.A. Wetzel^{1,3}, M.S. Baron^{2,3} and T. Adkins¹. ¹Department of Biomedical Engineering, VCU; ²Adult Neurology, VCU Medical Center; ³Parkinson's Disease Research, Education, and Clinical Center (PADRECC), McGuire VA Medical Center. Reading is a task which requires accurate eye position control and periods of stable eye position during fixation. Individuals with Parkinson's disease (PD) often report increased difficulty with reading and changes in reading habits. This study investigates the effects of PD on eye and head movements during reading through objective measurement and analysis of eye and head movements. The eye and head movements of 57 subjects, 23 controls and 34 PD patients ranging in age from 39 to 81 years have been measured. Eye and head movements were recorded at 120 times per second while participants read from 10 of 35 texts ranging in difficulty level from an elementary 1st grade level to a 12th grade level. As a measure of fixation stability, the absolute velocity of eye movement was computed for all subjects. Initial analysis of the fixation data revealed significant differences in the absolute velocity of eye movement between the age-matched control subjects and those with

PD. Stability differences were significant in both the horizontal and vertical directions. Subjects with more severe cases of PD showed greater eye position instability and less eye movement control resulting in greater reading difficulty.

DEVELOPMENT OF CELL-BASED SUBSTRATES FOR PROPAGATION OF HUMAN EMBRYONIC STEM CELLS. Sheena Abraham & Raj R. Rao Department of Chemical and Life Science Engineering, Virginia Commonwealth University Richmond, VA 23284. Maintenance of self renewal in human embryonic stem cells (hESCs) has traditionally required the use of mouse embryonic fibroblasts (MEFs) as a feeder layer. Unfortunately, concerns of xenogenic contamination, labor intensiveness and variability in experimental results have inspired researchers to explore alternative substrates ranging from a mouse basement membrane based gel, Matrigel, to human cells as feeder layers. Here we report the sustained undifferentiated growth of hESCs on immortalized human foreskin fibroblasts (ihFFs). Primary human foreskin fibroblasts have been shown to be a suitable alternate feeder layer. Hence, these cells may provide the appropriate physical properties as well as biochemical cues to sustain self renewal of hESCs. Human foreskin fibroblasts were immortalized with human telomerase reverse transcriptase (hTERT). Over initial passages analyzed, these ihFs have successfully maintained undifferentiated proliferation of pluripotent hESCs. Morphological analyses of hESC colonies and immunocytochemical techniques for specific stem cell markers have been used. Current studies are focusing on determining the efficacy of these ihFs to stably maintain the undifferentiated state of the hESCs over prolonged passages.

PROPOGATION AND PASSAGING OF HUMAN EMBRYONIC STEM CELLS SEPARATED FROM A FEEDER LAYER USING A UNIQUE MESH BARRICADE. Kelsey M. Albert¹ & Raj R. Rao², Dept. of Biology¹, Dept. of Chemical and Life Science Engineering², Virginia Commonwealth University, Richmond VA 23224. Human embryonic stem cells (hESCs) are pluripotent progenitors that are commonly grown on the surface of a feeder layer for attachment, nutrients, and growth support. A major challenge with culturing hESCs on feeder cells is the inevitable mixing of cell types, which places severe limitations on the full therapeutic and research potential of this cell type. A filter-based co-culture system, which physically separates hESCs from the feeder layer, while still allowing nutrient flow, is an attractive alternative to feeder layer-dependent culturing. Two different polymer materials, that comprise the mesh barrier of the culture dish inserts known as MilliCells (Millipore), were compared. Additionally, the mesh inserts were either coated with fibronectin or left untreated. Abnormal colony morphologies or lack of attachment were common problems for many conditions. For one complete passage, hESCs were cultured on the mesh inserts and imaged for colony morphology and cell attachment. After subsequent passaging of each condition onto MEF-seeded plates with no inserts, Alkaline Phosphatase analysis showed maintenance of pluripotency for all conditions. While these preliminary data show that more work is needed to optimize conditions and methods

necessary for hESC on this culture system, this study presents a novel and modular method for propagation of pluripotent progenitor cells.

TRANSCRIPTIONAL PROFILING OF CULTURE ADAPTED EMBRYONIC STEM CELL LINES IS ENRICHED WITH CHROMOSOME SPECIFIC GENE EXPRESSION AND ONCOGENIC GENES. Marion J. Riggs, Anjana Narayanan & Raj R. Rao, Chemical and Life Science Engineering, Virginia Commonwealth University, Richmond VA 23284. Human embryonic stem cells (hESCs) are an exciting cellular source for basic research and clinical application, and are defined by their ability to self-renew, differentiate into three germ layers, and maintain a normal karyotype. It has been shown recently that the genome of hESCs is subject to aneuploidy in a passaging-dependent manner. Results from our lab demonstrate that certain passaging methods can lead to chromosomal alterations. This poses a challenge for the mass propagation of cells prior to use in cell-based therapies. We have found that abnormal hESCs have a markedly different transcriptional profile, suggesting that differentiation studies are likely to be affected. Microarray analysis of 12 comparisons with our abnormal hESCs against 8 other normal hESC lines demonstrates that abnormal hESCs have a signature characterized by enrichment of genes located on specific chromosomes. 410 genes were found to be differentially expressed in at least 10 of 12 comparisons with 229 increasing and 180 decreasing. The chromosomal distribution of increased genes is significant, since it directly correlates with known trisomies of abnormal hESCs. These copy number changes serve as genomic landmarks to further identify key self-renewal regulators and proliferative mechanisms that provide abnormal hESCs selective growth advantage over normal hESCs. It is critical to address the mechanisms that could lead to genomic instability so as to develop propagation strategies for generation of chromosomally stable hESCs.

EFFECT OF SUBSTRATE RIGIDITY ON MOUSE EMBRYONIC FIBROBLAST MORPHOLOGY AND ADHESION. Nikolai A. Eroshenko¹, Curtis Taylor² & Raj R. Rao³, ¹Dept. of Biomedical Engineering, ²Dept. of Mechanical Engineering, ³Dept. of Chemical and Life Science Engineering, Virginia Commonwealth University, Richmond VA 23284. Engineering artificial substrates for seeding cells allows us to monitor, control and manipulate the cell's microenvironment for various cell mechanics studies. However, the substrates must preserve some of the key cellular features in order to use these for mechanotransduction studies. The long term goal of this project is to study the effects of substrate rigidity as it pertains to specific cellular properties of proliferation, differentiation and/or apoptosis. Towards this, we researched the effects of varying substrate rigidities on the morphology and adhesion of mouse embryonic fibroblasts. Results from previous studies suggested that fibroblasts should spread out on rigid substrates and become more rounded on softer substrates. We seeded mouse embryonic fibroblasts on polydimethylsiloxane substrates coated with either fibronectin or poly-L-lysine and analyzed their morphology and adhesion properties by phase-contrast microscopy. Our results suggest that the cells attained a more rounded morphology on the softer

substrates, while exhibiting a more extended morphology on rigid substrates. Our results also suggest that fibronectin synergistically interacts with the silicone surfaces in promoting adhesion. Poly-l-lysine-coated membranes were shown to be unable to support proper cellular attachment. These results lay groundwork for subsequent research in our laboratory with the focus on altering cell behavior based on substrate mechanical properties.

PREDICTION OF BREATHING PATTERNS USING NEURAL NETWORKS.

Pavani Davuluri, Rosalyn S Hobson, Chris Eley & Stephanie Wong, Dept. of Electrical Engineering, Virginia Commonwealth Univ., Richmond VA 23284. During the radio therapy treatment, it has been difficult to synchronize the radiation beam with the tumor position exactly. Many compensation techniques have been used. However, all these techniques have some system latency of up to a few hundred milliseconds. Hence, it is necessary to predict tumor position to compensate for the control system latency. In recent years, many attempts have been made to predict the position of a moving tumor during respiration. Analyzing external breathing signals presents a methodology in predicting the tumor position. Breathing patterns vary from very regular to irregular patterns. The irregular breathing patterns make prediction difficult. A solution is presented in this paper which utilizes neural networks as the predictive filter to determine the tumor position up to 400 milliseconds in the future. Three different neural network structures are used for prediction and the prediction results are given in the paper. On average, the prediction ability of these neural network structures is found to be acceptable.

ELECTROMYOGRAPHIC CHARACTERIZATION IN AN ANIMAL MODEL

OF DYSTONIA. Kunal D. Chaniary¹, Mark S. Baron², Ann C. Rice², Paul A. Wetzel¹, Steven M. Shapiro², Departments of ¹Biomedical Engineering and ²Neurology Virginia Commonwealth University, Richmond, VA, USA, 23298-0599. Kernicterus is known to produce damage to the auditory system and the basal ganglia in humans. Although the Gunn rat model of kernicterus has been extensively used to characterize the auditory features, this model has not been similarly utilized to systematically investigate the movement disorder.³³ In the present study, spontaneously jaundiced (jj) 16 day old Gunn rat pups were treated with sulfadimethoxine to exacerbate bilirubin toxicity and compared to saline treated jjs and non-jaundiced (Nj) littermates. Electromyographic activity was recorded from antagonistic hip muscles in dystonic and in normal appearing rats. The raw EMG signals were decomposed using the Discrete Wavelet Transform based multi-resolution analysis and signal coefficients corresponding to the dominant EMG frequency band were chosen. Gunn rats exposed to sulfadimethoxine developed a stable clinical state characterized by prolonged abnormal axial and appendicular postures. Coherence plots of the separated signals coefficients revealed 4-7 Hz co-activation in antagonistic muscles that was significantly more prominent in jj sulfa treated dystonic compared to normal rats. The EMG findings affirm the presence of

dystonia in sulfadimethoxine exposed jj Gunn rats and suggest that these animals can serve as a valuable model for experimental investigations of dystonia.

Botany

QUANTITATIVE ANALYSIS OF ANTIOXIDANTS IN FRESH APPLES AND FRUIT JUICES. Michael H. Renfroe, Frank N. Russo & Olivia C. Chang, Department of Biology, James Madison University, Harrisonburg VA 22807. Fresh fruits and fruit juices are recommended as part of healthy diets in part due to the presence of antioxidants, which are thought to help prevent various chronic diseases and provide multiple health benefits. We analyzed the antioxidant content of three cultivars of apples (*Malus domestica*), cv. Granny Smith, Gala, and Braeburn, and juices from cranberry (*Vaccinium macrocarpon*), pomegranate (*Punica granatum*), grape (*Vitis lambrusca*), grapefruit (*Citrus paradisi*), and orange (*Citrus sinensis*). Antioxidant content was measured using the ABTS/H₂O₂/HRP decoloration method, and means were compared using a one-way analysis of variance followed by Dunnett's T3 test for significance of differences of means. Apple peels were determined to be sources of antioxidants while apple pulp contained negligible concentrations of antioxidants. Granny Smith apples had the greatest concentration of antioxidants followed by Gala, with Braeburn containing the least. Results were comparable on a fresh weight and dry weight basis. Cranberry juice contained the greatest concentration of antioxidants, with grape containing less (though not statistically significant). Pomegranate juice contained less antioxidants, followed by grapefruit, although these two were not significantly different. Orange juice contained the least antioxidants. Studies of antioxidant content in fresh fruits and juices can provide information helpful to planning healthy diets.

AN HERBARIUM STUDY OF THE MORPHOLOGICAL CHARACTERS AND SYSTEMATICS OF ENDEMIC MEMBERS OF *CORDIA* L. (BORAGINACEAE) IN THE GALAPAGOS ISLANDS. Michael S. Woolf¹, Conley K. McMullen¹ & Andrea Weeks², ¹Department of Biology, James Madison University, Harrisonburg VA 22807 and ²Department of Environmental Policy and Science, George Mason University, Fairfax, VA 22030. Presently, seven species of *Cordia* L. (Boraginaceae) are said to inhabit the Galagos Islands. Four of these species are endemic (*C. anderssonii*, *C. leucophlyctis*, *C. revoluta*, *C. scouleri*), whereas three are non-endemic (*C. alliodora*, *C. lutea*, *C. polycephala*). The endemics, all of which are members of *Cordia* sect. *Varronia* (P. Browne) Roemer & Schultes, are thought to have arrived in the archipelago via long-distance dispersal by birds. Our project is using morphological and molecular characters in preparing a taxonomic revision of these endemics. Here we report our progress in using morphological characters to distinguish Galagos members of this genus. This study will ultimately provide a clear understanding of species limits and relationships, and reliable records of species distributions.

ECOLOGICAL COMMUNITIES OF THE KEISTER TRACT, SHENANDOAH COUNTY, VA. Heather M. Kepple, J. Andrew Clark, Catheline Huynh-Lam, Patrick C. Mulrooney & Woodrow S. Bousquet, Environmental Studies Department, Shenandoah University, Winchester VA 22601. During the spring and summer of 2006, Shenandoah University researchers conducted an ecological survey of property purchased in 2002 by Shenandoah County after the county recreation plan identified a need to develop a new park. Using the relev (Braun-Blanquet) method, five community plots were described by their physical and biological characteristics. Four ecological communities were identified using the classification system developed by the Virginia Natural Heritage Program. A total of 146 different plant species was found, including eight that represent new records for Shenandoah County. One endemic species, *Packera antennariifolius* (Shalebarren ragwort), was found within the site xeric shale woodlands, a distinctive but uncommon community of the central Appalachians. Based on the field data collected, recommendations for protecting and interpreting the Keister Tract ecological communities were developed. Cattle grazing should cease to reestablish the site natural qualities. The xeric shale woodlands should be protected by either restricting access or raising any trail crossings on elevated walkways. Riparian buffers at least 200 feet wide should be established along the Shenandoah River and Cedar Creek to help improve water quality.

PERFORMANCE OF INTRASPECIFIC HYBRIDS OF *LOBELIA CARDINALIS* IN A CONTROLLED ENVIRONMENT. Linda M. K. Johnson, Department of Biology, Chemistry, and Environmental Science, Christopher Newport University, Newport News VA 23606. The role of introgression in the evolution of natural populations is often investigated in concert with local adaptation. Previous "common garden" field studies using distant populations of *Lobelia cardinalis* indicated the potential for local adaptation. A growth chamber/greenhouse study of intraspecific hybrids of *L. cardinalis* tracked morphological and fitness characters for multiple filial generations and backcrosses. The *L. cardinalis* populations tested, though geographically distant, are sufficiently genetically similar such that hybrid vigor was more common than hybrid breakdown, but no consistent patterns of hybrid generation performance across measured traits were evident in a controlled environment. A comparison with the same populations in the field suggests that environment affects the expression of genetic variation in this species.

FLOWERING PLANTS: A REARRANGED BRANCH IN THE TREE OF LIFE (ATOL). Khidir W. Hilu, Department of Biological Sciences, Virginia Tech, Blacksburg VA 24060-0406. Recent advances in molecular biology and bioinformatics are having an immense impact on the field of systematic and evolutionary biology. Flowering plants (angiosperms) are among the groups that gained considerably from these new advances in knowledge. The traditional concepts of a basal split into monocots and dicots from members of the Ranunculales or Magnoliales are no longer tenable. Instead, the woody shrub *Amborella* is sister to all remaining angiosperms. The traditional classification of

angiosperms into subclasses is now replaced by a number of lineages that can be summarized as: 1) early diverging angiosperms that include the monocot lineage and 2) eudicots, that include a grade of lineages (early diverging eudicots) followed by a large clade called core eudicots. These new concepts of angiosperm systematics are supported by phylogenetic studies based on single gene sequence data, such as the plastid *matK* gene, and combined sequence information from two to several genes. However, parts of the phylogenetic tree of angiosperms remain problematic. A group of collaborators, including our lab, are currently working on resolving these difficulties with funds from the National Science Foundation intuitive “Assembly of the Tree of Life (AToL).”

WIND DISTURBANCE IN A VIRGINIA FOREST: DAMAGE ASSESSMENT AND PRE-DISTURBANCE SPECIES RECONSTRUCTION. Kjarstin A. Carlson-Drexler & Stewart A. Ware, Department of Biology, College of William and Mary, Williamsburg VA 23185. The ability to recover from natural disturbance is an important factor determining the future success of an ecosystem. Tree species, unlike animals, lack the ability to respond to a threat of disaster by finding shelter or relocating. In this study, damage to a 150-year old temperate forest caused by Hurricane Isabel in 2003 was quantified. In contrast to most forests damaged by hurricanes, the site used for this study has not been salvage-logged, making pre-hurricane reconstruction possible. This study site was a multi-hectare microburst area in the College Woods of the College of William and Mary, located in Williamsburg, VA. Damage in the area of strong localized winds (microburst) was compared to that in a less severely damaged area (reference). A total of 36 plots were set up in the microburst and reference areas of the forest, and species, diameter at breast high (dbh), and damage for all trees larger than a minimum size was recorded. The microburst site lost 63% of tree basal area, while the reference site lost 6%. In both sites, *Quercus rubra* lost the most basal area of all species. The percentage of trees damaged increased with increasing tree size, as did the percent of trees uprooted. Data collected in this study also allowed for the reconstruction of pre-hurricane forest composition. Prior to the disturbance, *Q. rubra* and *Liriodendron tulipifera* had the highest relative basal areas in the microburst site, while these positions were held by *Fagus grandifolia* and *Q. falcata* in the post-disturbance composition. Dominant tree species in the reference site did not change as a result of the disturbance.

ORDINATION AND CLASSIFICATION OF BOTTOMLAND FORESTS OF THE LOWER MISSISSIPPI ALLUVIAL PLAIN. Edward E. Dale, Jr¹, Stewart A. Ware² & Ben Waitman², ¹Department of Biological Sciences, University of Arkansas, Fayetteville AR 72701 & ²Department of Biology, College of William and Mary, Williamsburg VA 23187-8795. Studies of bottomland forests have traditionally focused on distribution of individual species along the flooding gradient, with relatively little attention to segregation into communities. Cluster analysis and ordination of 90+ bottomland forest stands in the Mississippi River Alluvial Plain in Mississippi, Louisiana, and Arkansas yielded 12 groups of stands

(community types). Stands and groups were arranged in a Y-shaped pattern across the ordination. A *Quercus nigra* group and a *Q. phellos* group occurred along a “less flooded” arm of the Y. A *Populus deltoides*-*Acer negundo* group, an *A. negundo* group, and a *Celtis laevigata*-*Carya illinoensis*-*Ulmus americana* group occurred along the “often flooded, flowing water” arm of the Y, the last group overlapping a *Q. texana*-*Fraxinus pennsylvanica* group near the middle of the ordination. A *Liquidambar styraciflua* group extended between the “less flooded” and the “flowing water” arms of the Y. The “often flooded, standing water” base of the Y had a *Taxodium distichum* group and a *Nyssa aquatica*-*Planera aquatica*-*T. distichum* group, with *Cephalanthus occidentalis* important in the understory in both groups. Two overlapping groups at the center of the ordination tied together the three arms of the Y. These were a *Q. lyrata* group and a *Carya aquatica*-*Forestiera acuminata* group. All except the *Acer negundo* group contained stands from multiple locations in two or more states, suggesting generality of these combinations of species in this region.

FLUEGGEA (EUPHORBIACEAE/PHYLLANTHACEAE): REVIEW AND PROSPECTS. W. John Hayden, Department of Biology, University of Richmond, Richmond VA, 23173. *Flueggea* Willd. is a pantropical genus classified in Phyllanthaceae (formerly Euphorbiaceae subfamily Phyllanthoideae). Since the revision published by Grady Webster in 1984, the supposed endemic Hawaiian genus *Neowawraea* Rock has been shown to be an unrecognized species of *Flueggea* and a newly described species from Turkey, *F. anatolica* Gemici, bring the genus to 15 species. Recently published molecular phylogenies suggest that *Richeriella* from the Asian tropics may also belong here, potentially increasing the number of species to 17. Wood anatomy has been important in assessing relationships, both within *Flueggea* and within Phyllanthaceae at large. *Flueggea* and several closely related genera possess a syndrome of features (simple perforations, septate fibers and scanty paratracheal axial parenchyma) known as *Glochidion*-type structure; most other Phyllanthaceae possess a mix of scalariform and simple perforations, non-septate fibers and abundant parenchyma in diffuse and diffuse-in-aggregate patterns. The congruence between wood anatomical data and DNA-based phylogenies is not, however, perfect, and work remains to resolve the conflicting signals provided by these independent sources of systematic data within Phyllanthaceae. Given the wide divergence in geography, habitat, and habit among the species of *Flueggea*, the genus affords an excellent arena for studies of structural adaptations within a single lineage of plants.

SECRETORY STRUCTURES OF THREE SPECIES OF *CNIDOSCOLUS* FROM YUCATAN, MEXICO. Catherine E. McLane & W. John Hayden, Department of Biology, University of Richmond, Richmond VA, 23173. The neotropical genus *Cnidocolus* includes some 50 species that range in habit from herbaceous perennials to shrubs and small trees. Three species from the Yucatan Peninsula were examined via light (LM) and scanning electronmicroscopy (SEM) to characterize their diverse secretory structures. The species studied are *C.*

aconitifolius (Mill.) I.M. Johnston, *C. chayamansa* McVaugh, and *C. souzae* McVaugh. Tissues from the petiole-blade junction were collected and fixed in a mixture of 70 percent ethanol and five percent glycerine. Paraffin-embedded sections were stained with hematoxylin-safranin for LM and intact samples were dehydrated, affixed to stubs, and sputter-coated with gold-palladium for SEM. Acropetiolar glands, characteristic of the genus, consist of a biseriate epidermis underlain by a densely-stained layer of secretory parenchyma that is three to six cells wide; xylem and phloem elements from petiole vasculature approach but do not enter the densely stained secretory layers. Glands are sessile in *C. aconitifolius* and *C. chayamansa* but elevated on vascularized finger-like stalks in *C. souzae*. Stinging hairs consist of a massive multicellular base, a large basal reservoir cell bearing a thick and lignified wall, a long tapered shaft, and a bulbous tip attached by a pre-formed zone of weakness. Stinging hairs are sparse and small in the semi-domesticated species, *C. chayamansa*, large and dense in *C. souzae*, and of intermediate size and abundance in *C. aconitifolius*. All three species bear similar non-articulated branched laticifers containing white latex.

THE FLORA OF VIRGINIA PROJECT: A 2006-2007 UPDATE. Marion B. Lobstein, Department of Biology, Northern Virginia Community College, Manassas VA 22205. Virginia, for its landmass, has the most diversity of vascular plant species of any state in the United States. It had the first flora, the *Flora Virginica* in 1739 yet does not have a modern flora. The Virginia Academy of Science for over eighty years has supported efforts to produce a modern *Flora of Virginia*. In 2001 the Foundation of the *Flora of Virginia*, Inc, was formed and in May 2002 received 501(c) 3 status. Progress continues to be made on the efforts to develop a *Flora of Virginia* including fund-raising and public outreach efforts. Work on the content of the *Flora of Virginia*, including nearly 260 of the core illustrations, has been commissioned, completed, and funded by VAS funds. An \$80,000 grant from the Virginia Environmental Endowment Fund is available to support development of the *Flora of Virginia*. The Academy, including the Fellows, continues to provide essential support including financial for this Project. Other progress includes completion of treatments of the dichotomous keys of 131 of the 205-210 vascular plant families in Virginia, and the first step in developing species descriptions for approximately 90% of Virginia's 3800 vascular plant species. The second and third steps of species description development are making significant progress. The University of Virginia Press has offered a contract to publish the *Flora of Virginia* in 2011-2012.

THE USE OF GIS IN DETERMINING THE SPREAD AND IMPACT OF INVASIVE PLANT SPECIES WITHIN A WETLAND COMMUNITY. James M. Yoder¹, Curtis A. Yoder¹, Catherine A. Devadason¹ & Wendy Cass², ¹Biology Department, Eastern Mennonite University, Harrisonburg VA 22801 and ²Shenandoah National Park, Luray VA 22835. In the spring of 2006, a three year project was begun to study the impact and control of invasive plants species in a unique wetland community in Shenandoah National Park. The Northern Blue Ridge

Mafic Fen plant community is a globally rare high-elevation wetland endemic to Shenandoah National Park. This community supports 48 rare plant populations and is of very high conservation value. Three non-native plant species; garlic mustard (*Alliaria petiolata*), Japanese stilt grass (*Microstegium vimineum*), and oriental lady's thumb (*Polygonum caespitosum*) are encroaching on the wetland from nearby trails, roads, and developed areas. Protection of the community and rare plant populations can only be done with extremely labor intensive hand-pulling. Before control was begun, the full extent of the invasion in relation to rare plant populations was visualized by collecting rare and invasive species abundance data at 1200 sample points placed on a 10 x 10 m grid. Maps displaying the areas of greatest potential impact of invasive species on rare plant populations were generated and used to develop a control strategy to protect the wetland. In addition, ongoing work on this project using GIS modeling will address two specific questions: 1) What is the rate of spread of the three most threatening invasive species and 2) What is the impact of these invasive species on the continued viability of the rare plant species located within the wetland?

INTERACTIONS OF ALLELOPATHY AND HEAT STRESS IN PLANTS. Derek W. Hambricht & Mary E. Lehman, Department of Biological and Environmental Sciences, Longwood University, Farmville VA 23909. Allelopathy involves the interaction of plants through the release of biochemicals into the soil, often negatively affecting the growth of surrounding plants. Little is known about how other plant stresses interact with allelopathy. Cucumber seedlings were grown in nutrient culture systems containing 0 – 0.6 mM *p*-coumaric or salicylic acid, two common allelopathic chemicals. The seedlings were also exposed to heat stress simultaneously with or following the allelochemical stress (36/32 ° C. day/night compared to control temperature of 26/22). Both salicylic acid (SA) and *p*-coumaric acid (PCO) inhibited the shoot and root growth of cucumber seedlings. The consistent main effect of heat stress was a significant reduction in root growth at the high temperature (36/32°C). There also were alterations of the growth patterns of cucumber shoots under heat stress. In most cases, no significant interactions were seen between allelopathy and heat stress effects on cucumber seedlings. However, one significant interaction was seen with simultaneous effects of PCO and heat stress on root growth, indicating the potential for interactions of these stresses under some conditions.

EVOLUTION OF THE CANARY GRASSES: A STUDY OF POLYPLOIDY AND BIOGEOGRAPHY. Rohit Kumar¹, Khidir W. Hilu¹, & Riccardo Baldini². ¹Department of Biological Sciences, Virginia Tech, Blacksburg VA 24060-0406, ²Botanica Sistemática, Dipartimento di Biologia Vegetale, Università degli Studi, I-50121, Firenze, Italia. *Phalaris*, canary grasses (Poaceae), is a genus of 21 annual and perennial species found in the temperate regions of five continents, but believe to have a Mediterranean origin. This taxonomically complex genus is characterized by various levels of polyploidy based on chromosome numbers of 6 and 7. In this study, we used sequence information from the ITS nuclear regions to reconstruct a

phylogeny for the genus and use it to assess species relationship and origin of polyploids. The 12 species used here formed four major clades. The species endemic to California appear sister to the rest of the genus, but bootstrap support is weak. Resolution within some subclades is low, which may be due to concerted evolution or low number of informative characters. A more robust phylogeny is being reconstructed using additional genomic regions.

Chemistry

EXPRESSION AND PURIFICATION OF A DELETION MUTATION OF THE CLONED HUMAN CAP METHYLTRANSFERASE IN *E. COLI*. C. W. Bannon, N. M. Tellmann, J. Chung, and T. O. Sitz, Dept. of Biochemistry, Virginia Tech, Blacksburg, VA 24061. The 5'-cap structure in eukaryotic mRNA is methylated in the N-7-position of the guanine base by the guanine-7-methyltransferase (GMT). This modification is essential for gene expression because if the cap is not methylated ribosomes don't bind to the mRNA and the message is not translated into protein. Dr. Shuman at Sloan-Kettering sent us two plasmids coding for the full length human GMT (FL-GMT, 476 amino acids) and a deletion mutation missing 120 amino acids from the N-terminus (-120 GMT, 121-476 amino acids). We transformed a strain of *E. coli* [BL21(DE3)-codon plus] with these plasmids. While the FL-GMT was expressed in *E. coli* without problems the deletion mutation was a challenge. We optimized the conditions for the expression and stability of the -120 GMT: Induced expression in *E. coli* at 17 °C, eluted the Ni column with 0.3 M Imidazole buffer, used 10% glycerol in elution buffer, added EDTA to samples, and stored the enzyme in 50% glycerol at -20°C. When expressing the enzyme at 17° C in 2% ethanol a major contaminating protein was found which bound to our Ni column. MS analysis identified this protein as an *E. coli* chaperone protein. By eliminating the ethanol in the media we reduced the amount of this contaminating protein and still had a high level of expression of the -120 GMT enzyme. We plan to develop some additional purification steps to produce highly purified -120-GMT to study enzyme interactions and the role of the N-terminal 120 amino acids.

ANTIFUNGAL COMPOUNDS PRODUCED BY BACTERIA FOUND ON THE SKIN OF AMPHIBIANS. Robert M. Brucker, Reid N. Harris & Kevin P. C. Minbiole, Dept. of Chem., James Madison Univ., Harrisonburg VA, 22807. Worldwide populations of salamanders are in decline, a fact that is partly attributable to infection from fungal pathogens including *Batrachochytrium dendrobatidis*. Experiments indicate that beneficial bacterial living on salamander skins produce antifungal compounds that may stave off infections. HPLC and GCMS analysis of crude bacterial isolates and comparison to known antifungal compounds (including pyoluteorin, pyrrolnitrin, and 2,6-diacetylphloroglucinol) have shown that 2,6-diacetylphloroglucinol is produced by at least one bacterial strain, *Lysobacter*. Other bacterial species are currently being investigated to confirm antifungal activity and elucidate known or novel antifungal compounds.

DESIGN AND SYNTHESIS OF SUPRAMOLECULAR FIBERS. Kevin L. Caran¹, Ashleigh R. Borges¹, Clayton M. Dingle¹, Nicholas P. Henrich¹, Angela M. Middleton¹, Karolina Z. Roszak¹, Marilise Hyacinth², Michal Sabat² & Lin Pu², ¹Dept. of Chem. MSC 4501, James Madison Univ. Harrisonburg, VA 22807 and ² Dept. of Chem., Univ. of Virginia, Charlottesville, VA 22904. Recent work in our laboratory has focused on the preparation of new amphiphiles in an effort to expand the variation and utility of supramolecular aggregation. In particular, these compounds have been designed to form fibrous aggregates (those with a high aspect ratio) in aqueous and/or non-polar environments. Novel structures include (1) biscationic single-chained amphiphiles with varied hydrophobic chain lengths, (2) partially fluorinated propargylic alcohols, and (3) amphiphilic catenanes. The synthesis of these molecules, as well as aggregation studies using NMR, surface tensiometry, differential scanning calorimetry, light microscopy and electron microscopy will be presented.

THE IMPACT OF METHIONINE DEPRIVATION ON THE METHYLATION OF THE MRNA CAP STRUCTURE IN KIDNEY CELLS IN CULTURE. J. Chung, A. J. Misiewicz, and T. O. Sitz, Dept. of Biochemistry, Virginia Tech, Blacksburg, VA 24061. Methionine is an essential amino acid in the diet of mammals. The limitation of methionine can decrease protein synthesis by restricting the amount of the methionine-tRNA or by limiting the amount of S-adenosylmethionine (SAM) synthesized. If cellular SAM levels are low methylation reactions in the cell can be restricted. If the methylation of the cap structure in mRNA does not occur, then ribosomes don't bind to the mRNA and the message is not translated into protein. Normal rat kidney cells (NRK) and pig kidney cells (PK) were grown in media without methionine. Post-Polysomal RNA (PP-RNA) was isolated and analyzed for non-methylated cap structures. The PP-RNA was isolated and hydrolyzed with NaOH and the resulting alkaline stable oligonucleotides were analyzed by DEAE-Sephadex ion exchange chromatography. There was no significant inhibition of cap methylation by limiting methionine in the media, probably due to the low K_m value of the guanine-7-methyltransferase for SAM (0.2 μM). However when NRK cells were treated with the amino acid analog cycloleucine, cap methylation was inhibited. Cycloleucine inhibits the synthesis of SAM by acting as a competitive inhibitor of the enzyme S-adenosylmethionine synthase which must then lower the cellular levels of SAM significantly below 0.2 μM . These results suggest that growth inhibition by limiting methionine in the media is due to the low levels of methionine-tRNA synthesized and not due to restrictions on cap methylation.

RELATING THE PHOTOCHEMISTRY OF HUMIC SUBSTANCES TO THEIR SPECTROSCOPIC AND ELECTROCHEMICAL PROPERTIES. Renee M. Dalrymple & Charles M. Sharpless, Department of Chemistry, University of Mary Washington, Fredericksburg VA 22401. Previous work in our lab has demonstrated a linear correlation between the quantum yield of $^1\text{O}_2$ (Φ_{so}) from irradiated humic substances (HS) and the ratio of HS absorbance at 254nm to that at 365nm (E2/E3 ratio). That earlier work was performed with standard HS obtained commercially.

In order to test the generality of this correlation, local HS samples from Lake Anna and the Rappahannock River were isolated by the XAD-8 resin adsorption method and ultrafiltration. Their E2/E3 and Φ_{so} values were measured and follow the previously observed trend. These results will be presented and discussed in the context of ongoing work to investigate the fundamental basis for the correlation. Initial results of experiments to study a similar correlation in the photochemical production of H_2O_2 by HS will also be presented.

THE THERMAL DECOMPOSITION OF AMMONIUM meta-VANADATE UNDER RESTRICTED FLOW CONDITIONS. L.R. Brock, J. W. Keister, M. France, N. Fierro, & T.C. DeVore. Dept. of Chem. MSC 4501, James Madison Univ. Harrisonburg VA 22807. The products obtained for the initial and final steps of the thermal decomposition of ammonium meta-vanadate were found to depend upon the container used to contain the sample. The decomposition in an uncapped container produced $(NH_4)_2V_4O_{11}$, $NH_4V_3O_8$, and V_2O_5 as the apparent stable products. The products in a capped container were $NH_4V_3O_8$, and V_2O_x where x was between 4 and 5. The different final product resulted from a reaction between one of the gaseous products (NH_3) and the V_2O_5 formed during the decomposition. An equilibrium model that contains reversible reactions whose rate depends on the amount of products in the cell can be used to explain the different reaction intermediates. This model will also explain why the apparent activation energies for a decomposition process can vary with the extent of reaction.

MIGRATION FROM LABWORKS TO MICROLAB FOR DATA ACQUISITION IN GENERAL CHEMISTRY II LABS. T. D. Hagedorn, A. L. Yeiter, & G. C. Grant, Department of Chemistry, Tidewater Community College, Virginia Beach, Virginia 23453. In 2008 when we occupy our new Chemistry facility, we are replacing LabWorks equipment (in use since 1999) with MicroLab a modernized outgrowth of the CCLI program sponsored by NSF. The new equipment selected was the MicroLab FS 522 Interface with integral multi-wavelength LED visible spectrophotometer. Importantly, MicroLab uses a 16 bit A/D which allows measurement of 0.1 mV and pH to 0.001 which allows research quality measurements for more advanced labs (Analytical, P. Chem., and Instrumental Analysis). We have reviewed and revised the experiments that involve data acquisition for measurement of temperature, pH and light (Beer-Lambert Law). We will present a detailed comparison of the two systems for ease of use, experimental design, scientific graphing, curve-fitting, and data analysis. Use of MicroLab software for some experiments will require instruction in Excel (not previously required with LabWorks). We will compare the use of the FS 522 spectrophotometer with older Spectronic 20 instruments.

EXPLORATION OF IONIC LIQUID AS SOLVENT AND STRUCTURE DIRECTING AGENT IN ALUMINOPHOSPHATE SYNTHESIS. Jeremy Harris & Barbara A. Reisner, Department of Chemistry, MSC 4501, James Madison Univ. Harrisonburg VA 22807. Due to their large pore sizes, open-framework

aluminophosphates (AIPO) have many uses in catalysis, molecular transport, molecular separation, and sorption. AIPO synthesis has been extensively investigated hydrothermally and solvothermally, but little is known about producing AIPOs with ionic liquids (IL) as the solvent. IL have received much attention for properties such as low vapor pressures, recyclability, high thermal stability, and its ability to dissolve metal salts and organic compounds. Several experiments have been performed to produce AIPOs ionothermally. AIPO-11, 41, 5 and other AIPOs have been successfully synthesized by varying temperature, heating duration, heat source, and structure-directing agents (SDAs). Reactions were conducted in Teflon-lined autoclaves or microwave test tubes for heating. X-ray Diffraction (XRD) was used to identify these compounds and document the trends that occurred upon changing reaction conditions; and Scanning Electron Microscopy (SEM) to analyze samples on the micrometer scale.

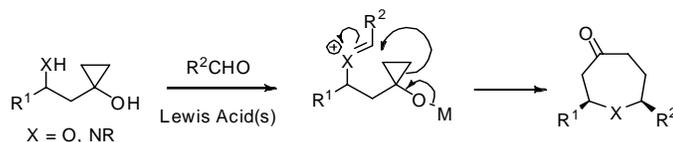
FLUORESCENCE LABELLING OF NEUROTRANSMITTERS AND METABOLITES Elizabeth A. Hochreiter & Gina MacDonald, Department of Chemistry, MSC 4501, James Madison University, Harrisonburg, VA 22807. The neurotransmitters serotonin (5-hydroxytryptamine, 5-HT), dopamine (DA), and their metabolites have been associated with a variety of physiological and behavioral functions. Consequently, many methods for determining the concentrations of these neurotransmitters and their metabolites have been developed. One of the most common methods of quantitation utilizes high-performance liquid chromatography (HPLC) in conjunction with fluorescence detection. Specific fluorescent labels attached to neurotransmitters and their metabolites can facilitate their identification and quantitation. In this study we attempted to use a variety of methods to derivatize compounds of interest. Benzylamine HCl was used to label 5-HIAA while fluorescein isothiocyanate isomer I (FITC) was used to label 5-HT and DA. Fluorescence spectra of the labeled compounds were obtained to ascertain if concentrations were proportional to the fluorescence intensity. All compounds showed fluorescence yet only the 5-HT samples' fluorescence intensity was proportional to concentration.

SYNTHESIS OF DIPHENYL KETONES. J. M. Joyce and G. P. Lutz, Department of Chemistry and Physics, Longwood Univ. Farmville VA 23909. The preparation of a series of symmetrical diphenyl ketones is being reported as part of a larger research project designed to investigate the regiochemistry of deprotonation reactions that may occur when enolate ions are exposed to an alkyl lithium base. The preparation of 1,5-diphenylpentan-3-one, 1,7-diphenylheptan-4-one, 1,9-diphenylnonan-5-one, and 1,4-diphenylbutan-2-one were accomplished and their structures were confirmed by proton (^1H) and carbon (^{13}C) nuclear magnetic resonance (NMR) analysis. Deuterium labeling reactions were conducted to obtain the previously unreported deuterium labeled compounds: 2,2,4,4-tetradeutero-1,5-diphenylpentan-3-one, 3,3,5,5-tetradeutero-1,7-diphenylheptan-4-one, 4,4,6,6-tetradeutero-1,9-diphenylnonan-5-one, 1,1,3,3-tetradeutero-1,4-diphenylbutan-2-one, and 2,2-dideutero-1,4-diphenylbutan-1-one. A comparison of ^1H and ^{13}C NMR

spectra between the deuterium labeled and unlabeled ketones was conducted to clearly distinguish between the alpha and the benzyl positions of each ketone target molecule.

ELECTROPHILIC AROMATIC SUBSTITUTION REACTIONS REVISITED: THE DEVELOPMENT OF STATISTICALLY DESIGNED EXPERIMENTS AS A LEARNING TOOL IN THE ORGANIC CHEMISTRY LABORATORY. J. A. Mann & G. P. Lutz, Dept. of Chem. and Physics, Longwood Univ. Farmville VA 23909. A statistically designed laboratory exercise was developed for the bromination of a variety of substituted aromatic compounds with all aspects of the experiment's development serving as learning experiences. Screening reactions were used to determine usable ranges for the chosen reaction variables: concentration of phenol in the solvent system, mole ratio of bromine to phenol, temperature, and water content of the solvent. The reaction time (time required for disappearance of bromine color in the reaction mixture), amount of phenol remaining, and amount of 2-bromophenol, 4-bromophenol, 2,4-dibromophenol, 2,6-dibromophenol, and 2,4,6-tribromophenol produced were monitored using GC analysis of the crude reaction mixture. The amounts of each compound present in the final reaction mixtures were influenced significantly by water content and mole ratio of bromine to phenol, and insignificantly by the concentration of phenol and reaction temperature. Design Expert 7 software was employed to produce statistics and response surfaces that show the effects of the variables on reaction outcome. Response surfaces for significant variables will be presented.

CYCLOPROPANE FRAGMENTATION STRATEGIES FOR HETEROCYCLE FORMATION. Marita C. Lawler & Kevin P. C. Minbiole, Dept. of Chem., James Madison Univ., Harrisonburg VA, 22807. The ring expansion of hydroxycyclopropanes can be exploited for the stereocontrolled formation of oxygenated heterocycles such as oxepanes. Progress towards the synthesis of homochiral nitrogenous heterocycles, particularly seven-membered azepines, via analogous fragmentation/recondensation strategies will be presented. Investigations into optimization of nitrogen protecting group will be discussed.



SOLUTION PHASE BEHAVIOR OF $\text{Ph}_2\text{PCH}_2\text{CH}_2\text{P}(\text{O})\text{Ph}_2$ WITH LANTHANIDE(III) AND LATE TRANSITION METAL IONS USING ELECTROSPRAY IONIZATION MASS SPECTROSCOPY. Morgan L. Moyer, Donna S. Amenta, Tom Gallaher, & John W. Gilje, James Madison Univ., Harrisonburg, VA 22807. We are interested in the coordination of $\text{Ph}_2\text{PCH}_2\text{CH}_2\text{P}(\text{O})\text{Ph}_2$ to lanthanide ions. Previously, we have crystallized and determined the structure of $[\text{Ph}_2\text{PCH}_2\text{CH}_2\text{P}(\text{O})\text{Ph}_2]_3\text{Ln}(\text{NO}_3)_3$, Ln = Ce, Tb, Yb, from the reaction of $\text{Ph}_2\text{PCH}_2\text{CH}_2\text{P}(\text{O})\text{Ph}_2$ with $\text{Ln}(\text{NO}_3)_3$. Electrospray Ionization Mass Spectra (ESI-MS) of methanolic solutions of these lanthanide complexes indicate complex solution equilibria. Complexes containing two, three and four ligands have been observed. Addition of Ni^{+3} , Co^{+3} , Pt^{+2} , Pd^{+2} to these solutions appears to favor formation of transition metal/ligand complexes at the expense of lanthanide/ligand complexes. When Ce^{+3} is added to solutions of $\text{Cl}_2\text{Pt}[\text{Ph}_2\text{PCH}_2\text{CH}_2\text{P}(\text{O})\text{Ph}_2]_2$, a complex containing the Pt^{+2} and Ce^{+3} is detected. This NMR data is consistent with this result.

IDENTIFICATION AND THE THERMAL DECOMPOSITION OF THE SURFACE SPECIES FORMED FROM THE REACTION BETWEEN ACETIC ACID AND ALUMINUM OXIDE. Matthew W. Ross & T.C. DeVore, Dept. of Chem. MSC 4501, James Madison Univ., Harrisonburg VA 22807. Aluminum Oxide is used in industry to dehydrate alcohols to make alkenes and as a support in several catalytic formulations that are used in a wide variety of other industrial processes. Investigations of the interactions between the catalytic surface and the reactant molecule provide insight into the catalytic mechanism and may offer insight that can be used to generate more efficient catalysts. The interactions between aluminum oxide and acetic acid are being investigated using FTIR and powder x-ray diffraction. By comparing the infrared spectrum and X-Ray diffraction patterns to those obtained for known aluminum acetate compounds, we established that aluminum hydroxyacetate was formed on the surface during the reaction between acetic acid and boehmite. TPD-FTIR established that acetic acid, ketene, and acetone desorbed from the surface as the sample was heated.

THE NATURE OF THE BLUE COMPLEX FORMED BY METAL IONS (Al^{3+} , Fe^{3+} , and Sn^{2+}) AND DELPHINIDIN IN ACIDIC ETHANOL: A CHEMICAL MODEL FOR THE BLUING OF HYDRANGEA SEALS. Henry D. Schreiber & Amy M. Swink, Dept. of Chem., Virginia Military Institute, Lexington Va 24405. Delphinidin, representative of the floral pigment in hydrangeas, occurs as a red flavylium cation in acidic ethanol. This red cation of delphinidin establishes equilibrium with a blue quinoidal base form in the presence of Al^{3+} in this solvent. Application of the method of continuous variation (Job's Method) indicates that a 1:1 molar complex forms between Al^{3+} and delphinidin. At high concentrations of Al^{3+} , a second bluing mechanism also becomes operational, as the spectrum of the red flavylium cation undergoes a bathochromic shift so that it also contributes to the resulting blue color. The limiting percentage of blue quinoidal base (complexed with Al^{3+}) with respect to all delphinidin is 50%, suggesting that the flavylium cation

associates with the complexed quinoidal base as an ion pair. Complexes of both Fe^{3+} and Sn^{2+} with delphinidin in acidic ethanol are analogous; however, the amount of excess metal ion required to achieve the limiting percentage of complexed blue quinoidal base increases in the order $\text{Al}^{3+} < \text{Sn}^{2+} < \text{Fe}^{3+}$ (that is, Al^{3+} forms the strongest complex with delphinidin, whereas Fe^{3+} forms the weakest). This chemical model provides a plausible mechanism for the red to blue transition observed in hydrangea sepals as a function of soil pH, which is a measure of the Al^{3+} availability in the soil. Other metals, such as Sn^{2+} and Fe^{3+} , have the potential to contribute to the bluing of the sepals.

ELUCIDATING THE VOLATILE CHEMICAL COMPONENTS OF TOWNSEND'S BIG-EARED BATS GLANDULAR SECRETIONS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY. Samuel Skalak, Daniel D. Clark & Richard E. Sherwin, Dept. of Bio., Chem. and Environmental Science, Christopher Newport Univ. Pararhinal glandular secretions of Townsend's big-eared bats (*Corynorhinus townsendii*), which are currently listed as a federal species of concern, were sampled in Pershing County, Nevada during the summer of 2006. These secretions were analyzed by GC/MS (gas chromatography/ mass spectrometry) for the separation of each component in the glandular secretions with concomitant mass spectral analysis. To date, the analysis of these chromatograms suggests that GC/MS may provide a useful tool for the identification of the chemical profile of the glandular secretions from Townsend's big-eared bats. Comparisons of the GC/MS chromatograms generated from the secretions of either male or female Townsend's big-eared bats as well as secretions found on habitat surfaces, where distinctive staining occurs during the formation of maternity colonies, revealed a distinct and consistent pattern or chemical profile for the species. Furthermore, comparisons of the GC/MS chromatograms generated from the glandular secretions of Townsend's big-eared bats to another bat species, *Antrozous pallidus*, revealed striking differences in the chemical profiles between the species. As a result, we are investigating the utility of this method to identify the current or historic use of specific habitats by Townsend's big-eared bats and we hypothesize that GC/MS may be a powerful and rapid method for the evaluation of these critical habitats for management purposes.

DONOR ATOM PREFERENCES IN SUBSTITUTION REACTIONS OF cis-PLATINUM MONONUCLEOBASE COMPOUNDS AND IMPLICATIONS FOR DNA-PROTEIN SELECTIVITY. Joseph Strukl & N.P. Farrell, Dept of Chem., Virginia Commonwealth University, Richmond VA 23284-2006. The reactivity of cis-platinum mononucleobase compounds containing cis-planar amines (CPA), cis-[PtCl(9-EtGua)(Py)₂] and cis-[PtCl(9-EtGua)(En)], where Py = pyridine and En = ethylene diamine, will be monitored using proton NMR. Compounds will be synthesized using previously reported methods. The binding selectivity of trans-platinum mononucleobase compounds towards the model substrates 5'-guanosine monophosphate (5'-GMP) and N-Acetylmethionine (N-AcMet) has been studied. A preferential binding in a 6:1 ratio favoring N-AcMet (protein model) was observed.

It is expected that this ratio of DNA to protein binding will be much lower in the case of cis-platinum mononucleobase compounds

Computer Science

SAFE COMPUTING AND VULNERABILITIES. Byron Davis, Nathaniel Graves, & Jeff Zadeh, Department of Mathematics and Computer Science, Virginia State University, Petersburg, VA 23806. This paper describes security practices related to computers. Computer security is a complex and constantly evolving field. Users of computer must be always aware of new threats and solutions and be proactive in assessing and protecting their systems. Safe computing is a matter of securing your system, network, server, and using common sense on the internet. It is recommended that you apply security practices and standards to all computers, whether they are connected to network or not. You should acquire a basic understanding of methods used by both computer security professionals and also those who seek to compromise a particular system's security. We should use the defensive and offensive tools to secure our computers. We also should educate the entire Internet community from the general user to the advanced programmer.

DENSE LINEAR SYSTEM SOLVER TEMPLATES FOR DISTRIBUTED MEMORY ARCHITECTURES USING MPI. S. V. Providence, Department of Computer Science, Hampton University, Hampton, VA 23668. Dense linear system solvers are important in many applications, such as: fluid flow around dynamic and static objects, solid body diffusion into a liquid, and noise reduction. When migrating from a shared-memory system to more available scalable distributed memory systems, alternatives for scalable parallel software libraries include: traditional function libraries, to protect legacy code; reactive servers on a network, that can respond to users special computational needs; general interactive environments, such as Mathematica; domain specific problem solving environments; or reusable templates, a description of a general algorithm rather than executable object code that offers whatever degree of customization the user may require. This paper explains how our $O(n \log^3 n)$ algorithms based on an algebra of scaling and displacement generators which describe dense general matrices, will be used with the message passing interface through templates to perform dense linear system solver computations.

TOWARDS CAPTURING REPRESENTATIVE ATTACK PATTERNS. Yen-Hung Hu, Department of Computer Science, Hampton University, Hampton VA 23668. To detect and defend against network malicious activities, monitoring and analyzing network communications and transactions over critical components of the Internet is the most trustful scientific implementation. However, it has existed several theoretical and applied challenges. Finding critical components to gather

sufficient information for identifying attacks is complicated and could not be solved practically on the current Internet infrastructure. Therefore, developing detecting models from simulations has provided an alternative approach and could be able to lower the implementation cost but still create acceptable results for implementation purposes. To achieve these objectives, traffic models that can represent variant attack patterns should be investigated first. Traffic models developed by using statistical and stochastic data of each attack along with Internet topology are worthy for further studies. In this paper, we focus on developing models of each attack upon a Power Law Internet infrastructure. Since assuming that infrastructure and protocols of the Internet are likely to be steady during the monitor period, we examine the variation of such models by changing the initial position (e.g., rich club or poor club, high degree or low degree) of each attack and its successful infection rate of each node (which is dynamically changed). We then are able to build multiple dimension maps, which can accommodate all possibility of this attack. By comparing a short historical trend of each attack, the prediction of its future behavior could be made from the data we have collected and analyzed.

A ROADMAP TO COLLABORATION. Robert A. Willis Jr., Department of Computer Science, Hampton University, Hampton, VA 23668. This presentation describes a rationale for institutional collaboration. It also discusses some common pitfalls that smaller academic institutions face when seeking collaboration opportunities with larger institutions. Some prescriptive measures and negotiation techniques are addressed.

Education

ASSESSING THE EFFECTIVENESS OF SCIENCE COURSES. Peter Martin, Department of Physics, Virginia Commonwealth University. This paper describes the features of and the assessment instruments for a new conceptual physics course for non-science majors 'Wonders of Technology,' developed at the Virginia Commonwealth University. The approach taken in teaching conceptual physics for non-science majors is by depicting its role in today's technology. The delivery of the course departs from the traditional one in a number of ways.

CONCEPTUAL PHYSICS FOR NONSCIENTISTS. Peter Martin, Adam Niculescu, Department of Physics, Virginia Commonwealth University. 'Wonders of Technology' was one of the Virginia Commonwealth University (VCU) new general education courses designed to improve students' scientific literacy by studying the process, concepts, and details of modern experimental science. The course is designed to appeal to non-scientists, to show them that exploring the world of technology can be fun, and that the conclusions from a science course can be applied to students' everyday experiences.

Environmental Science

GENETIC APPROACHES TO THE MANAGEMENT OF ISOLATED POPULATIONS OF *SALVELINUS FONTINALIS* IN SHENANDOAH NATIONAL PARK. Alicia Middleton¹, Barbara Lubinski², Tim King², & Lisa Webb¹, ¹Department of Biology, Chemistry, and Environmental Science, Christopher Newport University and ²U.S. Geological Survey, Aquatic Ecology Laboratory, Leetown Science Center. The objective of this study was to determine the genetic diversity of the brook trout (*Salvelinus fontinalis*) populations in Shenandoah National Park as well as to determine the smallest management unit for the species. Thirteen microsatellite markers were studied from 517 individuals sampled at 12 locations within the park. The only evidence of interbreeding between the locations sampled was between two locations in the same stream. Eighty percent of the variation between in allele frequencies was explained by differences within each population while only twenty percent occurred between them. Based on preliminary results, brook trout populations in Shenandoah National Park are reproductively isolated in each stream, and populations should not be combined into watershed groups or regions for management.

EVIDENCE OF CONTINUING LEAD POLLUTION FROM AUTOMOBILES. James H. Martin & Gabriel W. Martin, J. S. Reynolds Community College. The most commonly stated sources of environmental lead hazard are lead paint, leaded gasoline and soil contaminated by these two sources. In 1993, as a Virginia Junior Academy of Science project, it was proposed that lead balance weights from automobiles contributed a significant amount of lead to the urban environment. During a seven week period, six urban intersections were studied. Two of these intersections, with typical urban curbing and traffic flow from 32,000 -55,000 cars per day, yielded the largest quantities of lead (1497 & 1129 grams). These two intersections were cleaned of lead and new lead was collected early Sunday mornings for seven weeks. The average weekly yield was 101 grams per intersection. Lead weights falling into the intersections, mostly because of curb-wheel impact, were broken and ground into small pieces and finally small flakes or powder by the passing traffic. The half life of the visible, collectible lead was calculated to be 3.5 weeks. Lead analysis of the soil at the side of one intersection yielded 0.81 mg of lead per gram of soil. Lead analysis of the soil in a stream where the intersection runoff flowed yielded 2.50 mg lead per gram of soil. It was concluded that playing in this soil or inhaling wind or traffic-blown soil would present a serious health hazard to urban children.

USE OF A MATERNALLY INHERITED MARKER TO EXAMINE THE GENETIC STRUCTURE OF SOUTHEASTERN FOX SQUIRREL (*SCIURUS NIGER VULPINUS*) POPULATIONS. Katherine L. Bryant¹, Jes es E. Maldonado², Nancy D. Moncrief³ & Cody W. Edwards¹,¹Department of Environmental Science and Policy, George Mason University, Fairfax VA 22030; ²Center for Conservation and Evolutionary Genetics, Smithsonian Institution, Washington DC 20008;

³Virginia Museum of Natural History, Martinsville VA 24112. *Sciurus niger vulpinus* is a large tree squirrel whose range extends over the mid-Atlantic region. While molecular and morphological work has been undertaken to elucidate the validity and genetic structure of several other subspecies, *S. n. vulpinus* has received little attention. DNA was extracted from 42 samples of *S. n. vulpinus* from seven counties in Virginia and one county in Maryland, as well as 15 samples of *S. n. niger* and 13 samples of *S. n. rufiventer*. An additional nine haplotype sequences from *S. n. cinereus* from a previous study were incorporated into the analysis. A 280 base pair region of mitochondrial control region (d-loop) was sequenced using published primers. These data were analyzed using coalescent analysis and neighbor-joining methods with transversional weighting. Both analyses recovered four mixed clades, each comprised of two to four subspecies. *S. n. vulpinus* haplotypes were found in all four clades. The distribution of *S. n. vulpinus* haplotypes does not appear to correspond with sampling localities. These results indicate that control region haplotypes do not reflect geographic or subspecies designations, which suggests incomplete lineage sorting.

IMPACT OF COMMERCIAL DEVELOPMENT ON THE ECOLOGY OF TWO SMALL STREAM TRIBUTARIES OF THE RAPPAHANNOCK RIVER. Laura Maxfield and Michael Bass, Earth & Environmental Science, Univ. of Mary Washington. The purpose of this project was to monitor the stream health and assess the ecological damage on England Run and the Unnamed Tributary due to the continuing construction associated with the "Celebrate Virginia" North project in Stafford County, VA. This 1,372 acre project includes commercial areas, golf courses and residential subdivisions on what was previously a forested and lightly farmed area. To monitor the effects of construction on these streams, six sites were chosen along England Run as well as one on the Unnamed Tributary from the headwaters to shortly before the streams empty into the Rappahannock River. A survey of benthic macroinvertebrates was conducted at each station using EPA approved Rapid Bioassessment Protocol. Ephemeroptera, Plecoptera, and Trichoptera were counted and used to calculate taxa richness (%EPT) as compared to total organisms collected. These species are particularly sensitive to pollution. Water quality analysis was conducted at each station for DO, temperature, conductivity, and pH, alkalinity, hardness, nitrates, phosphates, total suspended solids and total dissolved solids. The Revised Universal Soil Loss Equation integrated with GIS techniques was used to address the effects of soil erosion within the on the stream ecology. Compared to a preconstruction study conducted in 2001, an overall decrease in organisms collected was seen, especially in the indicator species, with an uneven distribution within the %EPT towards Trichoptera. All water chemistry values fall within acceptable values and regulations set by the EPA. As illustrated by the RUSLE model of watershed erosion, an increase in embeddedness of stream habitats due to erosion within the watershed plays a key role in the decrease in %EPT and total organism counts along England Run and the adjacent Unnamed Tributary.

WATER QUALITY ASSESSMENT USING BENTHIC MACROINVERTEBRATES IN ABRAMS CREEK, WINCHESTER AND FREDERICK COUNTY, VA. R. Harden, A. Martin, H. Ruggeri, W. Seymour, & W. Bousquet, Department of Environmental Studies, Shenandoah University, Winchester VA 22601. Abrams Creek is listed as a stream with an impaired benthic community by the VA Department of Environmental Quality (DEQ). Using the EPA's rapid bioassessment protocol, researchers captured 3032 benthic macroinvertebrates (BMIs) from 27 different taxa to evaluate the water quality at six sites located from the headwaters to the mouth of Abrams Creek. After identifying and counting all BMI specimens, the researchers used the eight metrics of the DEQ's Virginia Stream Condition Index (SCI) to determine the degree of impairment at each site. The SCI calculations revealed that all sites are impaired, affirming the DEQ's measurements that were based on only a single Abrams Creek site. This study provides six additional sites with baseline data for future Total Maximum Daily Load (TMDL) monitoring, as required by the DEQ in accordance with Clean Water Act.

PYRENE DEGRADATION BY *PSEUDOMONAS FLUORESCENS* STRAINS 29L. Saleha Husain & Carol D. Litchfield, George Mason University, Fairfax VA 220304444. The intermediates and the enzymes involved in pyrene degradation by *Pseudomonas fluorescens* Strain 29L were studied. Strain 29L was grown with pyrene, 50 mg/L, as the sole carbon and energy source. The GC-MS analysis showed the presence of two and three fused-ring PAHs which for 21.8% of the carbon from pyrene in the mid-log phase. In the late log phase substituted benzenes accounted for 15% of the carbon from pyrene. By day 6, citric, oxalic, and pyruvic acids were present in higher concentrations compared to the other intermediates. All the enzymes are induced by pyrene and peaked in the log phase. The exception was salicylate 5-hydroxylase which had increased activity in the stationary phase. These data indicate that by *Pseudomonas fluorescens* Strain 29L degrades pyrene by multiple pathways.

POPULATION GENETICS OF TWO INVASIVE RODENTS (*RATTUS NORVEGICUS* AND *MUS MUSCULUS*) IN THE GALAPAGOS ISLANDS, ECUADOR. Tammy R Henry¹, Cody W Edwards¹, Michael Jarcho¹, Robert C Dowler², R Brand Phillips³ & Howard L Snell³, ¹Environmental Science & Policy, George Mason University, ²Dept of Biology, Angelo State University, and ³Dept of Biology, University of New Mexico. Despite being protected within the Galapagos National Park, the unique biodiversity of the Galapagos Islands is greatly impacted by human activities. Human movements have led to the introduction of invasive rodents, which have been linked to the rapid decline (and even extinction) of endemic rodents. Although *Rattus rattus* is widely distributed, *Rattus norvegicus* and *Mus musculus* are still very isolated. The impact of these species can be minimized if their dispersal patterns can be determined. A total of 43 samples of *R. norvegicus* (from three islands) and 93 samples of *M. musculus* (from seven islands) were collected. Although 10 polymorphic microsatellite loci for *R. norvegicus* and

7 loci for *M. musculus* have been identified, *R. norvegicus* samples have been completely processed at only 4 loci at this time. This preliminary analysis found that *R. norvegicus* shows good allelic diversity (for a small sample size) and overall high levels of heterozygosity. Analysis of population structure showed a distinct genetic separation of individuals from San Cristobal to both Santa Cruz and Rabida islands, but only a borderline difference between those from Rabida and Santa Cruz. The remaining polymorphic loci will strengthen the analysis and clarify the relationships and movement of *R. norvegicus*, as well as determine those associations for *M. musculus* on the Galapagos Islands.

MONITORING THE PROGRESS OF STORM WATER MANAGEMENT PONDS OF CENTRAL PARK AND AN OFF-SITE WETLAND MITIGATION PROJECT. Timothy O'Brien and Michael Bass, Earth and Environmental Sciences, University of Mary Washington. The Silver Company built the commercial Central Park, in an area with six acres of wetland and had to re-construct these lost wetlands in two other areas; benches around storm water management ponds that are in Central Park itself and an off-site in Spotsylvania County. The constructed wetland was created adjacent to a natural wetland. In 2002, construction of a housing development began on top of a hill next to the off-site mitigated wetland. Monitoring involved water analysis for dissolved oxygen, temperature, conductivity, pH, nitrates, phosphates, alkalinity, total hardness, zinc, copper, and manganese in both locations. Within the off-site wetland, a survey of woody stems was done to assess the progress of the site towards a forested wetland. A comprehensive list of woody and herbaceous species was generated showing a slight increase from last year, indicating succession toward a healthy wetland ecosystem. Soil coring in the constructed wetland was performed to look for reduced, hydric soil. The water analyses results showed no unusual levels of compounds tested were found in either the SMPs or the constructed wetlands and were well within required limits. A density of 535 woody stems per acre was calculated and is well above VDEQ's requirement of 400 woody stems per acre for a forested wetland. The soil coring showed hydric soil throughout the constructed wetland and in addition, in some areas that were originally designated as upland. Root analyses for zinc, copper and manganese was performed on three wetland plant species, *Arum arum*, *Hibiscus moscheutos*, *Typha latifolia*. Levels found were low. This wetland mitigation project has exhibited success and will be monitored in the future.

Medical Science

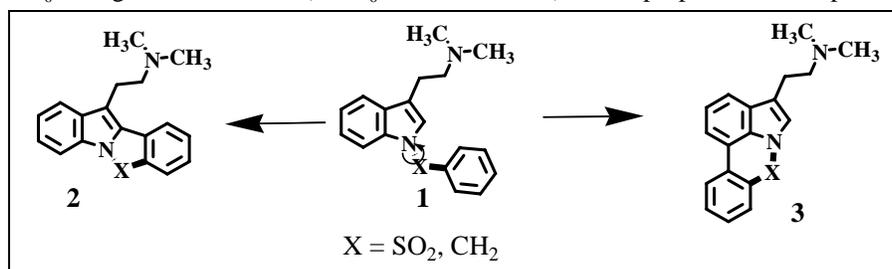
LOCOMOTOR EFFECTS OF MD-354/STIMULANT COMBINATIONS IN MICE. J. Worsham, R.A. Glennon, & M. Dukat, Department of Medicinal Chemistry, School of Pharmacy, Virginia Commonwealth University, Richmond, VA 23298-0540. *m*-Chlorophenylguanidine (MD-354) is a 5-HT₃ receptor partial agonist, thus it can indirectly modulate the release of dopamine (DA). Drugs of

abuse generally increase dopaminergic activity but this can occur through different mechanisms, such as causing the release of DA (amphetamine), or blocking DA reuptake (cocaine). We examined the effects of MD-354 on amphetamine and cocaine, to investigate if the 5-HT₃ receptor partial agonist modulates their stimulant effects, in comparison to a structurally similar non-stimulant such as DOM as a control. The results from the mouse locomotor activity assay show that MD-354 (doses up to 10 mg/kg) alone produced a saline-like effect for all parameters. For stimulant parameters such as movement episodes and movement time, amphetamine produced a stimulant effect at 3 mg/kg and above, yet no change was observed when administered with MD-354. This was opposite of cocaine, where MD-354 actually potentiated cocaine (10 mg/kg) stimulant effects. Varying doses of DOM produced a saline-like effect with stimulant parameters however, in combination with a 1 mg/kg dose of MD-354 the total movement time was suppressed. On non-stimulant parameters amphetamine and cocaine behaved similarly with potentiation of center entries (anxiolytic) in combination with MD-354, whereas DOM showed a reduction in effect. MD-354 could potentially be useful as drug-replacement therapy as it modulates stimulant and/or non-stimulant activity of amphetamine and cocaine, as well as decreasing anxiety. (Supported by: The Jeffress Memorial Trust RG-J-778).

DOES THE nAChR ALPHA-5 SUBTYPE PLAY A ROLE IN NICOTINE'S DISCRIMINATIVE STIMULUS? T.F. Gamage, R.E. Vann & M.I. Damaj, Department of Pharmacology and Toxicology, Virginia Commonwealth University, Richmond, VA 23298-0613. Neuronal nicotinic acetylcholine receptors (nAChRs) are pentameric structures composed of different α and β subtypes which express a variety of affinities for nicotine. Understanding the neuronal mechanism of nicotine's stimulus effects aids in developing pharmacological treatments for smoking addiction and facilitates research into nAChRs as a potential target for the treatment of cognitive deficits. This study investigated whether receptors containing the $\alpha 5$ subtype were integral for the subjective effects of nicotine. Wild-type C57BL/6 mice and $\alpha 5$ (-/-) littermates were trained to lever press for sweetened milk under an FR10 schedule of reinforcement to criteria, successful completion of 7 out of 8 consecutive operant sessions. Both wild-type and $\alpha 5$ (-/-) acquired nicotine's discriminative stimulus at an average of 51 (range 26-90) and 56 (range 41-86) days, respectively; these were not significantly different ($p > 0.05$). Following acquisition, dose effect curves for nicotine were conducted. Nicotine fully and dose dependently substituted for itself and no significant differences were found between genotypes. These data show that the $\alpha 5$ subtype is not necessary for nicotine's discriminative stimulus and that mice lacking the gene that codes for this protein are able to acquire the stimulus equally as well as wild-types. Thus, these data suggest that the $\alpha 5$ subtype is not a potential target for pharmacological treatments of smoking addiction. Further studies are needed to verify the similarities and/or differences in substitution patterns between mouse strains to elucidate putative differences that may be applicable to treatment of nicotine dependence.

N_1 -BENZYLTRYPTAMINES AS h -HT₆ RECEPTOR LIGANDS. Abner N. Nyandegé^a, Renata Konalos^a, Bryan L. Roth^b & Richard A. Glennon^a, ^aDept. of Medicinal Chemistry, Virginia Commonwealth University, Richmond VA, 23298, ^bDept. of Biochemistry, Psychiatry and Neurosciences, School of Medicine, Case Western University. Our laboratory identified one of the first 5-HT₆ receptor antagonists: the arylsulfonyl analog MS-245 ($K_i = 2.1$ nM). The purpose of the present investigation was to determine if the aryl and sulfonyl moieties, commonly assumed to be important, are actually required for high affinity binding. N_1 -Alkyl-, N_1 -benzyl-, and N_1 -benzenesulfonyl-substituted tryptamine were synthesized and affinities examined. N_1 -Alkyl analogs displayed low affinity ($K_i > 100$ nM) for 5-HT₆ receptors whereas the benzyl analogs displayed higher affinity (K_i ca 3-100 nM). However, there was little correspondence ($r^2 = 0.048$) between the 5-HT₆ receptor affinities of the examined benzyl and benzenesulfonyl pairs, suggesting they bind in a dissimilar manner. Current findings indicate that an aryl (or substituted aryl)sulfonyl (rather than benzyl) moiety is optimal for high affinity binding, and that the sulfonyl moiety contributes to affinity. In support of the latter concept, we found that the sulfonamide N_1 -phenylthio- N,N -dimethyltryptamine ($K_i = 90$ nM) binds with reduced affinity relative to its sulfonyl counterpart ($K_i = 6$ nM). Furthermore, the results suggest that N_1 -benzenesulfonyl- and their corresponding N_1 -benzyltryptamine counterparts bind in a different fashion. [Supported, in part, by NIMH grant MH 60599 and A. D. Williams Trust Fund.]

CONFORMATIONALLY-CONSTRAINED h 5-HT₆ RECEPTOR LIGANDS. U. Siripurapu¹, R. Kolanos¹, B.L. Roth², R.A. Glennon¹. ¹Dept of Medicinal Chemistry, VCU School of Pharmacy, VA-23298, ²Dept of Biochemistry, Pschiatry and Neurosciences, CRWU. Over the past several years our laboratory has focused on the development of 5-HT₆-selective agents; we identified the first *high-affinity* 5-HT₆ antagonist: MS-245 (5-HT₆ $K_i = 2.1$ nM). The purpose of the present



investigation is to identify the mode(s) by which 5-HT₆ agents might orient upon interaction with the receptor. To this end, the current study addresses the issue of the orientation of the X-phenyl substituent of MS-245-type compounds when they bind at 5-HT₆ receptors. That is, compounds of the type **1** (where X = SO₂ or CH₂) are conformationally flexible and rotation is possible, leading to the possibility of existing in three possible low energy conformers: $t = 60^\circ$, 180° and 300° . We prepared two conformationally-constrained forms of **1** (i.e., **2**, $t = 180^\circ$ and **3**, $t = 0^\circ$) to determine which of the two is optimal for binding. A receptor graphics model

shows that conformer **2** is favored. Compound **2** ($K_i = 140$ nM) was found to bind with higher affinity than **3** ($K_i = 4440$ nM). [Supported by MH-60559.]

EFFECT OF TDIQ ON CLONIDINE-INDUCED BEHAVIORS IN MICE. J. Worsham, G. Sirles, R. A. Glennon, & M. Dukat, Department of Medicinal Chemistry, School of Pharmacy, Virginia Commonwealth University, Richmond, VA 23298-0540. MD-354 (*m*-chlorophenylguanidine) is a unique 5-HT₃/ α_{2B} -adrenoceptor agent. Both receptors have been indicated to play a role in pain. Previously, we have shown that MD-354 potentiates the antinociceptive effect of an inactive dose of an α_2 -adrenoceptor agonist, clonidine, in the mouse tail-flick assay. And, the potentiation occurs in a complex biphasic manner. Therefore, it was of interest to determine if it is the affinity of MD-354 for 5-HT₃ receptors and/or the selectivity for α_{2B} -adrenoceptors that accounts for the potentiating actions of MD-354, as well as the biphasic dose response curve observed in combination with clonidine. This was investigated using TDIQ, which lacks 5-HT₃ receptor affinity ($K_i < 10,000$ nM) or α_2 -adrenoceptor subtype selectivity ($K_i < 100$ nM), in the mouse tail-flick and locomotor activity assays. The results indicate that TDIQ alone produced a saline-like effect in both assays. However, in the tail-flick assay, TDIQ (1.0 and 3.0 mg/kg; %MPE = 0 and 10, respectively) was found to significantly potentiate (%MPE = 69 and 82, respectively) the antinociceptive effects of clonidine (0.25 mg/kg; %MPE = 15) in a monophasic manner. Interestingly, TDIQ neither potentiated nor antagonized clonidine's hypolocomotor effects. The data suggest that TDIQ selectively potentiates the analgesic but not the sedative actions of clonidine. Because both agents share a common mechanistic component it might be concluded that potentiation of clonidine by these agents involves an adrenoceptor mechanism. (Supported by: The Jeffress Memorial Trust RG-J-778).

COMPARATIVE GENOMICS ANALYSIS OF NON-INSULIN DEPENDENT DIABETES MELLITUS ON HUMAN CHROMOSOME 1. Alicia Williams & Glenn C. Harris, Dept. of Biology, Virginia State University, Petersburg, VA 23806. Non-insulin dependant diabetes mellitus (NIDDM) is one of the most significant chronic human diseases, affecting over 20 million people in the United States (7% of the population). Despite the importance of understanding the causes and etiologies for this complex disease, to date very few genes have been identified that can explain the genetic susceptibility. This project uses the shared syntenic structure between human, rat and mouse genomes to build comparative genomic maps for QTL regions associated with NIDDM. Here we have used comparative genomics on human chromosome 1 to find two promising gene candidates for the disease, GBA (glucosidase, beta; acid) - an important enzyme in the glucose metabolism pathway, and RXFP4 (relaxin/insulin-like family peptide receptor 4) - a G-protein coupled receptor from the relaxin/insulin-like family of peptide receptors. Neither gene has been implicated as a candidate for NIDDM previously. These and other identified gene candidates represent prime targets for individualized functional analysis in future studies, including analyzing sequence variants such as single nucleotide polymorphisms (SNiPs), selecting specific animal models for functional

mutation studies, or whole-genome gene expression studies. This effort demonstrates that comparative genomics can dramatically improve the efficiency of using QTLs to find the ultimate causative agents of inherited diseases.

Natural History & Biodiversity

MOVEMENTS OF EASTERN BOX TURTLES (*TERRAPENE C. CAROLINA*) ON THE CEDAR CREEK BATTLEFIELD, FREDERICK CO., VA. Woodward S. Bousquet & J. Andrew Clark, Environmental Studies Dept., Shenandoah Univ., Winchester, VA 22601. A preliminary study of movements of eastern box turtles (*Terrapene c. carolina*) was conducted 29 June-4 November 2006 in forests of the Cedar Creek Battlefield, Middletown, VA. The site is part of the new Cedar Creek & Belle Grove National Historical Park (NHP). Radio transmitters (series SOPR-2190) were attached to carapaces of 11 adult turtles. Approximately every two weeks, the researchers mapped the subjects' locations using a 16-channel receiver (TRX-16S), GPS unit, and ArcGIS software. Home range areas, determined from least convex polygons, varied from 962-33,354 m². Removing one extremely large area resulted in an average home range of 3,356 m². Distances traveled averaged 293 m (with the highest and lowest distances removed) while daily travel rates averaged 5.5 m. Although subjects traveled through both upland and riparian deciduous forests, none were recorded in meadows or in early successional forests dominated by red cedar, *Juniperus virginiana*. Preserving this site's mature forests appears to be essential to protect box turtles and other species that share its habitats in the NHP.

GENETICS OF ANTHOCYANIN DEFICIENCY IN *SARRACENIA* L. II. Chelisse Perry^{1&2} & Phil Sheridan¹, ¹Meadowview Biological Research Station, Woodford, VA 22580 & ²Chesapeake Bay Governor's School, King George, VA 22485. *Sarracenia* is a genus of carnivorous plants found in wetlands of the U.S. and Canada. Insects are attracted to the plant by color, nectar, and scent and those insects which become trapped in the leaves are digested by a combination of bacterial action and enzymes. Flower and leaf color anthocyanins are controlled by many genes and we have identified a gene controlling one step in the anthocyanin pathway which contains red and green color alleles with red dominant to green. In 1998, a green plant was discovered in a population of *S. rosea* in Appalachian National Forest and we wanted to know if this mutation was caused by the same gene we had previously identified. We performed self-pollinations of wild-type plants from the Appalachian population and test crosses with green recessive mutants in other *Sarracenia* species. Self-pollination of a wild-type plant resulted in a good fit of a 3 red:1 green ratio while the interspecies test cross did not meet the expected 1 red: 1 green ratio. The test cross failed to meet expected ratios due to an over-abundance of green plants in one experimental pot. We attribute the green plant excess to vegetative budding in this one pot and were not able to separate vegetative budding from discrete plants. Phenotypes in the test cross clearly show

red and green colors and exhibit no incomplete or partial dominance. In conclusion, we think the dominant/recessive mode of inheritance is supported for this anthocyanin gene and that the green plant in Appalachian National Forest represents another occurrence of the same mutation in another *Sarracenia* species.

THE 2006 VIRGINIA SOCIETY OF ORNITHOLOGY BREEDING NORTHERN SAW-WHET OWL SURVEY. Andrew S. Dolby, Dept. of Biol. Sci., Univ. of Mary Washington, Fredericksburg, VA 22401. The 2006 VSO Breeding Bird Foray targeted a single focal species, the Northern Saw-whet Owl (*Aegolius acadicus*). During the last two decades, several banding stations across Virginia have monitored its fall migration, but little is known about its breeding distribution. The first record of a successful nesting attempt in Virginia was reported in 1995 in Highland County, and other anecdotal breeding reports have come from Shenandoah National Park and Mt. Rogers. We determined that a more systematic survey of breeding Northern Saw-whet Owls would contribute needed baseline data to support future conservation efforts. Eighteen participants completed 16 routes by automobile in 13 different counties. All but one county were situated along the Blue Ridge or bordered West Virginia. Routes were 6.5k long, with stops 800m apart. Each survey stop was 15min long, during which short audio-playbacks were alternated with listening periods. Owl responses were detected at fifteen out of 125 total survey stops, a 12% response rate. While the peak number of responses occurred in Montgomery County, a total of six survey routes yielded at least one vocal response. Our results reinforce prior anecdotal evidence that breeding Northern Saw-whet Owls are more widespread in western Virginia than previously thought and may justify a reconfiguration of this species' range map to include a corridor that connects the southern edge of the contiguous breeding population in western Maryland to the isolated pocket along the Appalachian spine to the southwest. This survey was limited in scope, but calls strongly for more extensive monitoring of breeding Northern Saw-whet Owls in Virginia.

LONG TERM AND SHORT TERM RELATIONSHIPS BETWEEN PHYTOPLANKTON DIVERSITY, PRODUCTIVITY, STABILITY, AND NUTRIENT AVAILABILITY. Todd A. Egerton, Christopher A. Binckley, Ryan Morse, Harold G. Marshall & Kneeland K. Nesius, Department of Biological Sciences, Old Dominion University, Norfolk VA 23529. Two fundamental questions in ecology are; how are diversity gradients generated and what are the ecological consequences of diversity. Recent findings of global declines in biodiversity have strengthened the importance of these questions. This study uses data from the long term (20 year) Chesapeake Bay phytoplankton monitoring program, and a smaller (34 day) daily sampling of phytoplankton in the Lafayette River, Norfolk, VA, to investigate relationships between diversity, productivity, stability and environmental factors. Within the large-scale study, there is a significant positive correlation between phytoplankton diversity and productivity, as well as diversity and stability. However in the smaller study, due to the occurrence of two algal blooms, there is a negative relationship between diversity and

productivity. An analysis of the combined datasets suggests that the actual relationship between phytoplankton diversity and productivity may be uni-modal in highly eutrophic conditions. This project is a component of ongoing research supported by Virginia DEQ and USEPA.

RANGE AND DISTRIBUTION OF A RARE TERRESTRIAL SALAMANDER. William Flint, Dept. of Biol., James Madison Univ., Harrisonburg, VA 22807. The Cow Knob salamander, *Plethodon punctatus* is a rare species of woodland salamander that is patchily distributed within a narrow range in Virginia and West Virginia. Because of its specific habitat requirements and low dispersal ability, *P. punctatus* has been shown to be particularly vulnerable to environmental disturbances. Large areas within the range of this species are remote with few or no roads and as a result this species' exact distribution has not yet been documented. The objectives of this study were to delineate the range of *P. punctatus* and identify any isolated populations of this species. Through a series of short and long distance foot travel surveys, I extended the range of *P. punctatus* 30 miles south along Shenandoah Mountain with new site locations in Augusta, Highland and Bath Counties in Virginia. I also identified new populations on Great North and Crawford Mountains in Augusta County, Virginia. Additionally, I verified the presence of two highly isolated populations of *P. punctatus* in Hardy and Hampshire Counties in West Virginia. I believe that the distribution of the Cow Knob salamander on Shenandoah Mountain is very close to being completely delineated. This study was funded by the West Virginia Division of Natural Resources.

EFFECTS OF THE INVASIVE TREE, *AILANTHUS ALTISSIMA*, ON THE BIODIVERSITY AND ABUNDANCE OF UNDERSTORY PLANTS. Sally Gallagher & Alan Griffith, Dept. of Biol. Sciences, Univ. of Mary Washington, Fredericksburg, VA 22401. Invasive plant species have been shown to impact local plant communities in many ways. Impacts include decreases in biodiversity and abundance. Yet, some studies show just the opposite results and for invasive species the impacts have not been measured. Lab results show the invasive tree *Ailanthus altissima* is allelopathic and its toxin does decrease the germination and growth of many plants. The goal of this work was to determine the impact of *A. altissima* on understory plant biodiversity and abundance. We located four stands of *A. altissima*. Six subplots were randomly chosen under the canopy of each *A. altissima* stand and six subplots under an adjacent native forest stand. Plant species richness, species stem count, and species percent covers were recorded for each subplot. Species richness of all plants was not affected by *A. altissima* presence. Invasive species richness was greater beneath *A. altissima*. Vine abundances were higher under the *A. altissima*. Unexpectedly, the herbaceous dicot abundances were also greater under the invasive canopy. In conclusion, we found that *A. altissima* does not seem to negatively affect the community diversities as expected. To the contrary, some functional groups grew better under the cover of this reputed, allelopathic invasive.

PRELIMINARY SURVEY OF DRAGONFLY SPECIES OF HANOVER COUNTY, VA. Richard S. Groover, Department of Biology, J. Sargeant Reynolds Community College, Richmond, VA 23285. During the summer and early fall of 2006, 88 dragonfly adults were collected from 15 different lentic and lotic sites across Hanover County, VA. The county has a total area of 1,228 km². The study was undertaken to establish a preliminary official list of field verified species for this county. Collected species included: *Arigomphus villosipes*, *Celithemis eponina*, *Celithemis elisa*, *Erythemus simplicicollis*, *Erythrodiplax minuscula*, *Gomphus lividus*, *Gomphus exilis*, *Libellula lydia*, *Libellula cyanea*, *Libellula vibrans*, *Libellula pulchella*, *Libellula incesta*, *Pachydiplax longipennis*, *Perithemis tenera* and *Progomphus obscurus*. The study did not focus on density per site or within the county, although several species were found to be present at more than one site.

INFLUENCE OF LAND USE AND DISTURBANCE HISTORY ON LONG-TERM VEGETATION CHANGES IN AN EASTERN FOREST. Christine J. Small, Department of Biology, Radford University, Radford, VA 24142. This study examined long-term changes in the vegetation of the Bolleswood Natural Area, a ~65 ha ecological research site in the Central Hardwoods-Hemlock Forest region of southeastern Connecticut. Vegetation and site data were collected at ten year intervals from 1952 and 2002, in 890 permanent 9 m² quadrats. Seven major vegetation types, including wetland, post-agricultural, and upland forest communities, were identified based on NMS ordination and UPGMA cluster analyses. Of these, post-agricultural communities were most compositionally distinct. In these stands, tree growth and compositional diversity declined significantly as the result of *Celastrus orbiculatus*, an invasive vine, interrupting typical successional dynamics. *Tsuga canadensis*-dominated forests more than doubled in basal area from 1952 to 1992, reflecting forest maturation after 1938 hurricane damage. Introduction of the hemlock woolly adelgid in 1987 caused rapid *T. canadensis* decline, reducing basal area by more than 75%, and initiating a shift to *Quercus*-dominated forests. Wetland communities showed little compositional variation over the study period. Across the study site, basal area increased dramatically (~93%) over the past 50 years, yet diversity declined, with significant losses of herbaceous species. Composition has shifted toward more mesophytic species, particularly *T. canadensis* (prior to the adelgid) and *Acer rubrum*. *Quercus* spp. have shown reduced regeneration, potentially due to white-tailed deer herbivory and prolonged absence of fire. Long-term ecological studies such as these are critical to our understanding of forest successional dynamics and novel contemporary influences.

FACTORS INFLUENCING THE INVASION OF *ROSA MULTIFLORA* INTO NATURAL AREAS OF THE SELU CONSERVANCY, SOUTHWESTERN VIRGINIA. Breanna L. Hargbol & Christine J. Small, Department of Biology, Radford University, Radford VA 24142. Invasive species are detrimental to natural systems, frequently altering the abiotic environment and aggressively displacing native species. To determine the growing conditions when the invasive plants

became established at the Selu Conservancy in southwestern VA, 28 – 10 x 10 m plots were established in summer and fall 2006, using random GPS coordinates. In each plot, the abundance of all native and non-native trees, shrubs, woody vines and herbaceous plants was determined, and light availability, soil fertility and topographic variables measured. Data were analyzed using NMS ordination to identify factors influencing invasive plant growth. Seven tree cores were taken from areas of high *Rosa multiflora* abundance and the annual growth rings measured. Invasive species most abundant in sample plots were *Rosa multiflora* (multiflora rose; 82% of sample plots), *Lonicera japonica* (Japanese honeysuckle; 71% of plots) and *Berberis thunbergii* (Japanese barberry; 21% of sample plots). NMS ordination explained 72.7% of the data variation. Analysis of tree cores and NMS ordination results suggested that high light, high soil moisture and fertility, and lower slope positions favor invasives such as *L. japonica* and *R. multiflora*. Intact forest canopies and poorer soils seem to deter these species but allow the spread of other invasives such as *B. thunbergii*.

MAP ANALYSIS OF INVASIVE PLANT DISTRIBUTION RELATIVE TO LAND USE AND SITE CONDITIONS IN SOUTHWESTERN VIRGINIA. Laura J. Clement & Christine J. Small, Department of Biology, Radford University, Radford VA 24142. Geographic Information Systems (GIS) allow for the integration of spatial and non-spatial data layers and investigation of relationships between them. This study examined the relationship between land use and distribution of invasive exotic plants in Selu Conservancy in southwestern Virginia. A GIS database was constructed to map the distribution of invasive plants throughout Selu Conservancy. Field data were collected in summer 2006 on native and invasive plant species and site conditions, including soil composition, light, topography, and historical land uses. These spatial data was overlain onto 2002 aerial photographs to analyze relationships between the distributions of invasive plants and site conditions. Locations of high invasive plant cover also were recorded using GPS and added to the GIS database. These results allow us to identify areas of significant invasive impact and to identify site characteristics that promote the spread of invasive plant species. By monitoring these characteristics, we can better predict areas impacted by invasive plants and establish management priorities.

A PHYLOGENETIC REVIEW OF THE MITOCHONDRIAL CYTOCHROME OXIDASE SUBUNIT 1 REGION ACROSS ANURAN FAMILIES. Jeffrey W. Streicher¹ & Cody W. Edwards², ¹ Dept. of Molecular and Microbiology, ² Dept. of Environmental Science and Policy, George Mason University, Fairfax, VA 22030-4444. The mitochondrial cytochrome oxidase subunit 1 (CO1) gene is commonly used in vertebrate phylogenetics. To our knowledge no published study has examined the evolution of this region among frog and toad (Amphibia: Anura) families. In the present study we investigate whether phylogenetic analyses conducted using amino acid and nucleotide characters derived from the same sequence data recover congruent topologies. In addition, we report new CO1 sequence data for the hyloid family Brachycephalidae and examine the placement of

this putative taxonomic group of direct-developing frogs. Comparisons between 14 anuran families representing all major lineages resulted in weakly supported but similar topologies congruent with previous phylogenies. Amino acid data were relatively conserved and created better supported and more strongly resolved topologies than the highly variable nucleotide data which is indicative of selective pressures acting on protein structure. Initial results recover Brachycephalidae as extremely derived, in comparison to other hyloid lineages, suggesting a significant increase in the group's rate of evolution. This characteristic is consistent with the chromosomal variation and biodiversity (+800 species) observed in this family. Based on these data, it appears that amino acids create the strongest familial-level CO1 phylogenies; however, extended taxon sampling and data from other coding regions are needed to ultimately determine the phylogenetic significance of anuran CO1.

THE EFFECTS OF LIGHT DIFFERENCES ON LEAF DAMAGE IN *CERCIS CANADENSIS*. Mary Swaney & Alan Griffith, Dept. of Biol. Sciences, Univ. of Mary Washington, Fredericksburg, VA 22401. Tree leaves can experience leaf damage from spots of fungal growth and leaf consumption by herbivorous insects. Damage that results in a decline of photosynthetic rate per leaf may lead to decreased tree growth. A species found in different light environments may show variable leaf damage and growth rates. *Cercis canadensis* grows in light and shade environments. In these microclimates *C. canadensis* incurs a variety of leaf damage caused by one or more attackers. The objective of this study was to estimate impacts of light level on leaf damage. Leaves, on light and shaded trees, were sampled late summer 2005 and early and late summer 2006 from 4 different sites. Total percent leaf damage was greater on shaded leaves in 2005. There was no significant difference in total % leaf damage, percent damage by lesions or percent damage by fungi between the two light environments in the early and late 2006 samples. However, percent leaf damage attributed to leafhoppers was significantly greater on shade tree leaves. It appears that leaf damage can vary between years, possibly driven by annual differences in abundance of damage agents. Results also suggest shade trees may incur a greater photosynthetic loss due to damage by leafhoppers than light trees.

EFFECTS OF HABITAT AND CLIMATIC VARIABLES ON AVAILABILITY OF VOLANT BAT PREY IN SOUTHERN PINE FORESTS. D. C. Horchler, K. M. Womack & A. D. Fink, Department of Biological and Environmental Sciences, Longwood University, Farmville VA 23909. Recent research in the United Kingdom found a significant relationship between bat activity and intensity of land management. The elucidated link between vegetation management, insect communities, and bat foraging activity also could apply to managed timber lands, a potential link that we investigated in pine stands managed under various regimes. In the summer of 2006, we conducted research in the Appomattox-Buckingham State Forest of central Virginia in sites representing several common young forest types. In each site we established a sampling array consisting of a central bat detector and

4 associated insect light trap locations. We determined dry biomass and identified to order those insects that were within a predicted prey size range. We used standard methods to assess bat activity and characterize understory vegetation. In a subsample of data collected in the 2006 field season, mean total dry mass of insect catches in the prey size range was 8.36 g in the youngest stands, 7.91 g in intermediate stands, and 5.19 g in the oldest stands. We determined the average total vegetation cover to be 16.7%, 42.6%, and 47.7% in the age classes, respectively, with important variation among height classes. As in the UK project, we found positive associations of bat activity and insect abundance, though in contrast, our more intensively managed sites had greater insect biomass. This raises interesting questions about the roles of these young plantations as foraging sites for bats, and results of this on-going work will provide relevant information to managers interested in non-game use of these areas.

EFFECT OF SEED, PLANT, AND POPULATION DENSITY ON THE PRE-DISPERSAL SEED PREDATION OF *AESCHYNOMENE VIRGINICA*, A RARE WETLAND LEGUME. Kadeana Langford & Alan Griffith, Dept. of Biol. Sciences, Univ. of Mary Washington, Fredericksburg, VA 22401. We studied the effect of density on pre-dispersal seed predation rates in 15 extant populations of *Aeschynomene virginica*, a threatened wetland legume, at the Cumberland Marsh Preserve in New Kent County, Virginia. A total of 27,872 seeds (eaten or uneaten) were counted on 583 randomly sampled *A. virginica* plants in September 2006. Densities were defined and varied by scale in the following manner: number of seeds per plant, seed density per population, plant density in a population, and population density. Seed predation rates were defined as either percent of seeds eaten per plant or average percent of seeds eaten in a population. Seed predation per plant increased with increased in seed production per plant ($R^2 = 0.055$, $p = 0.009$), and increased seed density per population ($R^2 = 0.038$, $p = 0.030$). This suggests that higher seed production densities attract more predators and increase the percentage of seed loss. Seed predation per population decreased ($R^2 = 0.414$, $p = 0.018$) with increased population density. This suggests that the predators have limited mobility so, with a more isolated a food source, seed predators will accumulate to that same closest food source. These results are consistent with the density dependence of pre-dispersal seed predation rates in *A. virginica* at several scales.

Psychology

EXAMINING CLOZE PROBABILITY AND ESTABLISHING COMPLETION NORM FOR 500 SENTENCES. Cady Block & Carryl Baldwin, Dept. of Psychol., Old Dominion University, Norfolk VA 23529. The present descriptive study examined cloze probability, or the proportion of persons utilizing a particular word to complete a sentence. One aim was to establish updated standardized sentence completion norms based on the original 1980 norms set forth by Bloom and Fischler (1980). In total, 500 sentences were utilized, 400 developed by the author, and 100

high constraint sentences from the varied-uncertainty and low-uncertainty (LU) set selected from Bloom and Fischler's study to be used as a comparison group. Four hundred undergraduate psychology majors completed the study as an online survey; the sample size was chosen to reflect that of the original Bloom and Fischler 1980 study. It is hoped that the sentence norms presented in the present study will be of use to other researchers interested in the effect of context on word processing. It was hypothesized that the sentence contexts presented in the 400 new sentences would meet the standards for high cloze sentences, defined as a cloze probability of 67 to 100%. Sentences meeting these criteria will be utilized in a speech processing task in a Master's thesis project examining age-related differences in speech processing as evidenced in N400 event-related potential electrophysiological measures. Of the 500 sentences utilized in the present study, 401 met the criteria for high cloze probability; of these 401 sentences, 321 were from the 400 developed by the author. Thus, the present study was quite successful in its endeavor to create 400 high cloze sentences comparable to Bloom and Fischler's benchmark set.

THIRD PARTY SEXUAL HARRASSMENT: A SPECIAL CASE OF HARASSMENT PERPETRATION. Valerie Morganson & Debra Major, Dept. of Psychol., Old Dominion University, Norfolk VA 23529. Despite the wide body of sexual harassment literature which has accumulated over the years, relatively few studies have asked the simple question: which parties harass in an organization? We explore this question directly while seeking to theoretically and empirically demonstrate the significance of third party harassers, a group which has received relatively little research attention. Third-party harassers include anyone outside of the worker's organization encountered during the course of performing one's job responsibilities (e.g. customers and workers of interfacing businesses). A group of working college students are surveyed to explore the role of third party harassment in generating sexual harassment outcomes (job satisfaction and health) the Sexual Experiences Questionnaire (SEQ: Fitzgerald et al., 1995), SF-12 measures of physical and mental health, as well as two measures of job satisfaction from the Job Descriptive Index family. Hierarchical linear regression models revealed that sexual harassment predicted two job satisfaction facet scores and mental health. Additionally, results support that third party harassment explains significant incremental variance above organizational harassment in predicting coworker satisfaction and mental health, at least at a trend level.

A COMPARISON OF DBA/2 AND C57BL/6 MICE IN TWO-LEVEL DRUG DISCRIMINATION WITH THE ATYPICAL ANTIPSYCHOTIC DRUG CLOZAPINE. D.M. Walentiny¹, S.D. Philibin², S.A. Vunck¹, J.H. Porter¹, ¹Dept. of Psychology, Virginia Commonwealth University, Richmond, VA 23284-2018, ²Dept. of Behavioral Neuroscience, Oregon Health & Science University, Portland, OR. The atypical antipsychotic drug (APD) clozapine (CLZ) demonstrates higher efficacy in the treatment of refractory schizophrenia relative to other APDs. CLZ displays a rich receptor binding profile, attaching strongly to serotonergic, dopaminergic, muscarinic and adrenergic receptors. CLZ drug discrimination (DD)

is a preclinical behavioral test used to study APDs and has been established in rats, monkeys, pigeons and most recently in our lab, in C57BL/6 mice (Philibin et al., 2005). DBA/2 mice differ from C57BL/6 mice in a variety of behavioral measures, suggesting that there may also be differences between the two strains in the CLZ DD task. In the present study, DBA/2 mice were trained to discriminate 2.5 mg/kg CLZ from vehicle in a two-lever operant chamber and the results of testing with several APDs and selective ligands were compared to previous results with C57BL/6 mice. DBA/2 mice readily acquired the two-lever CLZ discrimination with full generalization at 2.5 and 5.0 mg/kg ($ED_{50} = 1.28$ mg/kg), similar to results observed in C57BL/6 mice ($ED_{50} = 1.14$ mg/kg). The atypical APD olanzapine (OLZ) required a higher dose (2.0 mg/kg; $ED_{50} = 0.73$ mg/kg) to produce full substitution in the DBA/2 mice as compared to the C57BL/6 mice (1.0 mg/kg OLZ; $ED_{50} = 0.24$ mg/kg). The typical APD haloperidol (HAL) partially substituted for CLZ in the DBA/2 mice with a maximum 68.19 % drug-lever responding (%DLR) observed at the 0.2 mg/kg dose. However, in the C57BL/6 mice HAL produced a maximum of only 51.6 %DLR. While the dopamine agonist amphetamine (AMPH) failed to produce any meaningful CLZ-appropriate responding in either strain, it took a higher dose (2.0 mg/kg) to significantly reduce response rates in DBA/2 mice as compared to C57BL/6 mice (1.0 mg/kg). Scopolamine produced partial substitution (> 60 %DLR) for CLZ at 2.0 mg/kg in both strains of mice without response rate reductions. These initial results suggest that dopamine might be a more salient part of the CLZ discriminative cue in DBA/2 mice than in C57BL/6 mice, based on the partial substitution observed with HAL, as well as the difference in dose of AMPH required to significantly disrupt response rates in the two strains. Additional testing of typical and atypical APDs as well as selective ligands is needed to fully characterize the discriminative stimulus properties of CLZ in DBA/2 mice and will allow for more precise comparisons to the C57BL/6 strain. Support: This research was supported in part by NIH Grant 1 F31 GM070974-03 to SDP.

BEHAVIORAL TOXICOLOGY OF NON-ICHTHYOTOXIC *PFIESTERIA SHUMWAYAE*: An Anxiety Measure Indicated by Elevated Plus-Maze Behavior. Scott W. Vernon & Perry M. Duncan, Dept. of Psychology, Old Dominion University, Norfolk VA 23529-0267. *Pfiesteria shumwayae* (*P. shumwayae*) is an abundantly planktonic dinoflagellate found in mid-Atlantic marine and estuarine environments. This organism has been labeled as the causative agent in major estuarine fish-kill events and under controlled laboratory conditions has had a lethal effect on fish. Cognitive deficits such as short-term memory loss and difficulty with new task acquisition have occurred in humans accidentally exposed to ichthyotoxic *Pfiesteria*. Current research to date has not been able to determine the mechanisms by which *Pfiesteria* becomes toxic; however, previous research has demonstrated deficits in memory performance and new task acquisition in rat models after acute exposure. The experiment represented here investigated whether rats exposed to a filtrate from waters containing non-ichthyotoxic *P. shumwayae* cultures behaviorally indicated increased or differing levels of anxiety compared to control animals. Rats in the experimental group were given intraperitoneal injections of filtered water taken from aquaria containing *P. shumwayae* cultures and tested in the

elevated plus-maze (EPM), an apparatus sensitive to anxiogenic and anxiolytic effects. The measure of increased anxiety was defined by the amount of time subjects spent in the closed arms of the EPM, and the total number of arm entries. The results did not support the hypothesis (mean differences between experimental and control groups were not significant at the $p < .05$ level) that rats exposed to a filtrate of non-ichthyotoxic *P. shumwayae* would behaviorally indicate greater anxiety compared to control rats. However, an interaction between the results do provide practical information for future studies focusing on *Pfiesteria*'s potential to produce non-ichthyotoxic agents that have neurotoxic effects on mammals resulting in anxious behaviors that may interfere with learning and memory performance. In summary, the current study adds to the evolving body of research focused on identifying and understanding the neurotoxic effects of toxins produced by dinoflagellates. (Supported by: The Centers for Disease Control and Prevention, The Virginia Department of Health).

Statistics

ERROR MODELING IN GEOGRAPHIC INFORMATION SYSTEMS. Kimberly R. Love¹, Eric P. Smith¹, Stephen P. Prisley² & Keying Ye³, ¹Department of Statistics, Virginia Polytechnic Institute and State University, Blacksburg VA 24061, ²Department of Forestry, Virginia Polytechnic Institute and State University, Blacksburg VA 24061 and ³Department of Management Science and Statistics, University of Texas at San Antonio, San Antonio TX 78249. A Geographic Information System (GIS) is a flexible tool that allows researchers to effectively utilize maps in many applications. As GIS applications have become more popular, users are paying more attention to the unavoidable presence of error in GIS data sets. Probabilistic and statistical methods are currently gaining popularity for displaying and analyzing this error. We will provide an overview of the problem and the current statistical methods used for coping with error. We will also discuss our own work in the area, including the application of Bayesian methodology.

STATISTICAL ISSUES IN METABOLOMICS. David Banks, Institute of Statistics and Decision Sciences, Duke University, Durham NC 27708. Metabolomics is a new area in bioinformatics, with great potential for diagnosis and health management. This talk reviews five specifically statistical challenges that arise in the capture and analysis of metabolomic data: assessment of variance components in the measurement process, instrument calibration, peak identification, data mining to predict disease status, and compartmental modeling to model describe flows in the metabolic network. Although the talk focuses on statistics, it will not be extremely mathematical.

SMOOTHING SPLINE FRAILITY MODEL. Pang Du, Department of Statistics, Virginia Polytechnic Institute & State University, Blacksburg VA 24061. The frailty model has been a popular tool to model heterogeneity of individuals in different subpopulations. In the model, an individual's hazard rate depends partly on a frailty term, which is an unobservable random variable and is supposed to act multiplicatively on the hazard. In this presentation, we propose a penalized likelihood approach. Via the minimization of a functional consisting of negative full log likelihood and roughness penalty, the baseline hazard function and the frailties are jointly estimated, one non-parametrically by smoothing splines and the other parametrically with the log-normal distribution. The performance of the model is demonstrated by empirical studies and real data examples.

IMPROVED ESTIMATION OF THE EXPONENTIAL LOCATION PARAMETER UNDER AN ORDER RESTRICTION. Steven T. Garren, Department of Mathematics and Statistics, James Madison University, Harrisonburg VA 22807. Suppose two independent observations are drawn from two-parameter exponential distributions with unknown but equal scale parameters and an order restriction on the unknown location parameters. An isotonic regression estimator of the smaller location parameter stochastically dominates a preferred marginal estimator. The results expressed herein advance the theory of order restricted inference.

BASIC STATISTICAL ANALYSES USING MATHCAD. Archie W. Earl, Sr., Department of Mathematics, Norfolk State University, Norfolk VA 23504. MathCad is a very powerful software package for performing very high level mathematical computations and manipulations, but did you know that you can use it to do certain statistical analyses also? This paper sheds a little light on some of the basic statistical analyses for which it can be used. First computing basic statistics such as the mean, median, mode, range, variance, and standard deviation are discussed. After that, information is presented on using MathCad to perform correlation and several types of regression analyses. Information is also presented on using MathCad for data visualization.

