

## ABSTRACTS OF PAPERS

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### Aeronautical and Aerospace Sciences

COUPLING OF A NONLINEAR LIFTING-LINE METHOD TO AN EQUIVALENT PLATE ANALYSIS FOR CONCEPTUAL AIRCRAFT DESIGN. D. Bruce Owens, National Research Council, NASA Langley Research Center, Hampton, VA 23681-0001. In order to minimize design cycle time and to bring higher fidelity to the conceptual design phase of aircraft, a nonlinear aerodynamic method has been developed and coupled to a structural analysis method, ELAPS. The nonlinear lifting line (NLL) method is based on Weissinger's lifting line model. ELAPS is an equivalent plate analysis technique. In general, both methods have similar geometry input and run times. Furthermore, both methods have similar accuracy when compared to higher order methods. In order to make use of these tools in the conceptual design phase the methods incorporate characteristics of a design oriented analysis technique. They provide adequate accuracy, computational efficiency, precision for speed tradeoff, minimal time for geometric input and modification, and coupling to other methods. Having these characteristics allows for the use of these methods in a multidisciplinary design optimization process. In support of NASA's Environmental Research Aircraft and Sensor Technology (ERAST) program, the methods were used in the study of a very high aspect ratio wing aircraft called Condor. Due to the highly flexible wing the aeroelastic effects have a large impact on the design of the aircraft. The aeroelastic studies using the NLL and ELAPS methods predicted a tip deflection within 5% of that measured by experiment. The amount of washout also compared well with measured data. With similar geometry input, run times and accuracy, the coupling of the NLL and ELAPS are ideal tools for use in the conceptual design phase of aircraft.

A SHELL-TO-SOLID TRANSITION FINITE ELEMENT FOR IMPROVED INTERLAMINAR STRESS RESPONSE IN COMPOSITE LAMINATES. Darin D. Schultz, Aerospace and Ocean Engineering Dept., Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061-0203. A transition element (TR15Q) is developed which permits an accurate and practical technique for coupling shell element models to three-dimensional finite element models. Since the nodal degrees of freedom of shell and solid elements are incompatible, direct connection is not possible. However, this difficulty is overcome by degenerating a continuum element through kinematic constraints compatible with shell deformations. The shell-to-solid transition finite element (TR15Q) formulation is based on a higher-order shell theory that allows stretching in the through-the-thickness direction. The stretching degrees of freedom are eliminated by static condensation and assuming the actions associated with stretching vanish. This modelling technique is found to virtually eliminate the artificial stress boundary layer induced by previous transition elements which are based upon the kinematic assumptions of first order shear deformation theory. Finite element models composed of shell elements, a small region of solid elements, and transition elements, were created in order to study free edge effects in composite laminates. Results are presented for extension and bending of a  $[0/0/90/90]_s$  T300/5208 graphite-epoxy laminate. The models produced excellent predictions of the interlaminar stress response near the free edge of the laminate and displayed no contamination of the three-dimensional stress field near the transition interface.

**A HYBRID AIRSHIP CONCEPT USING AN INBOARD WING ARRANGEMENT.**

M.Leroy Spearman, NASA Langley Research Center, Hampton, Virginia 23681. A hybrid airship concept is proposed as a civil air transport intended to alleviate some of the concerns currently faced by conventional transport aircraft. The proposed concept is composed of two airship-type hulls that are connected by a cambered wing. The hulls contain helium to provide buoyant lift for all stages of flight while the wing, in forward flight, provides an additional kinetic lift to enhance the heavy-lift capability of the system. In addition, such a system would eliminate the community noise problem through taking off and landing in the buoyant mode; would enhance airport compatibility (take-off and landing delays) by eliminating the need for runways; would continue to operate in adverse weather that might limit visibility or cause iced runways; would be fail-safe in the event of power failure or control system failure. It is expected that the flight speed of such a vehicle would be substantially greater than that of previous airships through the use of new materials and structures and through the use of new propulsion systems. Even though the flight speed might be somewhat less than that for conventional airplanes, it is anticipated that the overall trip time might be reduced because of the elimination of takeoff and landing delays.

**Agriculture, Forestry and Aquaculture Science****ONTOGENETIC CHANGES AND ENVIRONMENTAL HYPOXIA: RESPONSES OF TWO FISH SPECIES TO LOW DISSOLVED OXYGEN LEVELS AT EARLY LIFE STAGES.**

David L. Balfour and A. G. Heath (\*), Dept. of Biol., Va. Polytechnic Inst. & State Univ., Blacksburg, Va. 24061. The effects of hypoxia (having oxygen levels below normal) in fathead minnows (*Pimephales promelas*) and rainbow trout (*Oncorhynchus mykiss*) during their development were examined to determine the basis of the changes in their tolerance to low dissolved oxygen levels. Fish were sealed in modified air-tight beakers and oxygen consumption on a per weight basis was compared between fish of different ages. Breathing rates were also monitored at each stage tested to determine whether the reaction of the fish to hypoxia changed with development. Finally, fish were exposed to carbon monoxide to determine the relative importance of hemoglobin in developing individuals. Younger fish were more tolerant of hypoxic conditions than older individuals. Breathing rate increases tended to be greater in older fathead minnows than those in younger individuals possibly as a result of more developed respiratory musculature. Breathing rates in older rainbow trout were found to slowly decline in the face of decreasing oxygen levels. Finally, it was found that hemoglobin may be of greater importance to rainbow trout at a younger age, than for the fathead minnow.

**NON-TREE SOURCES FOR MANUFACTURE OF PULP AND PAPER PRODUCTS.**

Harbans L. BHARDWAJ, Agri. Res. Station, Va. State Univ., Petersburg, VA. 23806, & Glenn S. Sakamoto\*, USDA-NRCS, Plant Materials Ctr., Hoolehua, HI. 96729. The United States imports approximately two-thirds of its newsprint at an annual cost of about \$4.5 billion. Kenaf (*Hibiscus cannabinus* L.), Sunn Hemp (*Crotalaria juncea* L.), and Industrial Hemp (*Camabis sativa* L.) have potential as non-tree alternate sources of pulp and newsprint. Kenaf can produce upto 17 MT/ha dry matter in Virginia with minimal inputs. During 1997, an extremely dry year, potential of Sunn Hemp, a nitrogen-fixing legume plant, was compared to that of kenaf. The dry matter yields when planted on May 15, were 7.2, 5.1, and 4.7 MT/ha for kenaf, sunn hemp grown from rhizobium-inoculated seed without any nitrogen fertilizer, and sunn hemp grown from uninoculated seed with 100 kg N per ha applied to the crop, respectively. Even though, the biomass yields of industrial hemp (Low-THC marijuana) can be as high as 9 MT/ha, drug regulatory provisions preclude its production in the United States. Given the advantages of kenaf (low inputs, high yield, availability of technology and know-how to produce pulp and newsprint from kenaf, low bleaching requirements, etc.), attempts to develop annually renewable alternates to using trees for pulp and newsprint should focus on kenaf and sunn hemp.

FISH HEALTH PROBLEMS OF RECIRCULATING SYSTEMS IN VIRGINIA AQUACULTURE. M. David Crosby, Cooperative Extension, VA State Univ., PO Box 9081, Petersburg, VA 23806. Fish health problems from recirculating systems vary with producer expertise, system design, and cultured species. The number of cases received from recirculating fish production systems has fluctuated from year to year. In 1997, one half of all cases received (30 cases total) at the VSU Fish Health Diagnostic Laboratory came from recirculating systems while in previous years it has been about 20-25% of the casework load. Tilapia is the most frequently submitted sample from recirculating systems. Other species include hybrid striped bass, ornamentals, eels, and summer flounder. Typically, about 40% of all problems are attributed to parasites. *Ichthyobodo* (*Costia*), *Trichodina*, and gill worms (monogenes) are typically found to be causing the problems for producers. Bacterial infections are the second leading cause of problems. Over the last two years, emphasis on controlling disease outbreaks has changed to preventing disease outbreaks. This has resulted in a significant increase in requests for laboratory fish examinations for the detection of pathogens such as *Streptococcus* in recirculating systems.

SEASONAL WATER QUALITY CHANGES IN HYBRID STRIPED BASS PRODUCTION PONDS. M. David Crosby and Scott H. Newton, Cooperative Extension, VA State Univ., PO Box 9081, Petersburg, VA 23806. Water quality data were collected over a two year period (96 and 97) from six production ponds rearing hybrid striped bass (HSB). Water Quality data reflects HSB being fed twice a day in 1/4 acre ponds versus once a day feeding in 1996. The 1997 water quality data reflects HSB fed two different feeds based on protein levels. The water quality parameters, TAN, hardness, pH, nitrite, and temperature were measured weekly while alkalinity was recorded monthly. Oxygen and water temperature also were monitored daily during the production period. Gypsum was added to the HSB ponds to increase hardness before the stocking of fish. Total water hardness in the production ponds was increased to 119-221 ppm due to gypsum. During the production season, hardness levels gradually decreased to nearly pre-gypsum hardness levels of the source water, the Appomattox River. TAN levels typically remained below 2 ppm and nitrite levels reached only trace levels for HSB production ponds in both 1996 and 1997.

VALIDATION OF THE PROBABILITY DENSITY FUNCTION AND OF NORMALIZING TRANSFORMATIONS FOR FECAL EGG COUNTS IN YOUNG AND MATURE GOATS. T.A. Gipson, Agric. Res. Station, Va. State Univ., Petersburg, VA 23806. Normality of the data is a basic assumption of analysis of variance and if this assumption is violated, then the statistical tests and decisions are invalid. A common statistical mistake is to assume that the data are normally distributed and not to test for normality. In small ruminants, greater emphasis is being placed upon innate resistance to internal parasites, which is a major impediment to profitable production. Indirect measures of resistance are fecal egg counts (FEC). FEC on 165 weaned kids were examined to evaluate its probability density function (pdf) and to investigate normalizing transformations. The Shapiro-Wilk statistic, *W*, revealed that FEC was not normally distributed ( $p < .01$ ). FEC were evaluated against discrete distributions of negative binomial and Poisson and continuous distributions of gamma and chi-square. Negative binomial and chi-square pdf's gave the "best" fit. Natural and base-10 logarithms and square, cube and quartic root transformations were examined as to their usefulness in normalizing FEC. None of the transformations rendered FEC normally distributed based upon criteria using the mean, mode, median, skewness, kurtosis and *W* statistic. The base-10 logarithm and quartic root transformations yielded the "best" attempts at providing a normal distribution. FEC can be approximated by a negative binomial distribution and a  $\log_{10}(FEC+10)$  transformation gave an approximate normal distribution.

RESULTS OF A BLIND CONSUMER ACCEPTANCE TRIAL OF SAUSAGES CONTAINING CHEVON, SINGULARLY OR IN COMBINATION WITH BEEF OR PORK. T.A. Gipson<sup>1</sup>, P.P. Graham<sup>2</sup>, J.R. Collins<sup>1</sup>, and T.D. Wilson<sup>1</sup>, <sup>1</sup>Agric. Res. Station, Va. State Univ., Petersburg, VA 23806 and <sup>2</sup>Dept. Of Food Science, Va. Polytechnic Inst. & State Univ., Blacksburg VA 24061. It has been hypothesized that a value-added goat product such as sausage might have high appeal among the non-goat consuming public. A double-blind taste test was conducted to determine the consumers' acceptance of five different sausage formulations featuring goat meat. Formulations included 100% goat meat with goat fat (G), 50:50 blend of goat and beef (GB), 50:50 blend of goat and pork (GP), goat meat with beef fat (GBF) and goat meat with pork fat (GPF). One-hundred-thirty-nine respondents used a consumer acceptance score card with preferences ranging from "Dislike Extremely" (value of 1) to "Like Extremely" (value of 5) to score the acceptability of the products. GP and GPF formulations received significantly ( $p < .05$ ) higher average scores of 4.0 and 3.9 (rating of "Like Slightly"), respectively, than the other formulations. The GBF formulation received a significantly ( $p < .05$ ) lower average score of 3.0 (rating of "Neither Like nor Dislike") than the other formulations. GB and G formulations received scores of 3.6 and 3.5, respectively, and were midway between the two ratings of "Like Slightly" and "Neither Like nor Dislike". The addition of pork and/or pork fat to goat sausage appeared to increase the consumers' acceptability of the product.

STEROLS, ALCOHOLS, AND HYDROCARBONS IN LUPIN SEED OIL AS AFFECTED BY GROWING LOCATION: Anwar A. Hamama and Harbans L. Bhardwaj, Agricultural Research Station, Virginia State University, Petersburg, Virginia 23806. Lupin (*Lupinus* sp.), long known and used as an efficient nitrogen-fixer, is being evaluated in Virginia for use in the sustainable crop production systems and to provide nutritious food and feed. The basic information about oil characteristics of lupin seed grown in Virginia is unknown. This study was conducted to characterize the contents of the major phytosterols, triterpene alcohols and related unsaponifiable components in lupin seed oil and to determine effects of growing environment. The composition of seed of 12 lupin lines grown in Maine during 1989/90 was compared to the seed of same 12 lines grown in Virginia.  $\beta$ -sitosterol (56.4-60.3%) and lupeol (90.8-97.5%), respectively were the most predominant components in the phytosterol and triterpene alcohol fractions. The order of sterols was  $\beta$ -sitosterol > campesterol > stigmasterol. The hydrocarbons with carbon chain between C22 and C26 were the most abandoned compounds in the non-polar fraction. A small fraction of n- Alcohols with carbon chain between C18 and C26 was also detected. The growing location had significant effect on the contents of oil, total sterols,  $\beta$ -sitosterol, and  $\alpha$ -amyrin. The seed grown in Maine had significantly higher contents of oil, saponification value,  $\beta$ -sitosterol, and  $\alpha$ -amyrin as compared to those grown in Virginia. The seed grown in Virginia had significantly higher content of phytosterols as compared to those grown in Maine.

REDUCTION OF SOYBEAN SEED PHYTATE CONTENT THROUGH GENETIC ENGINEERING. Carla E. Hegeman and Elizabeth A. Grabau, Dept. of Plant Path., Physiol., and Weed Sci., Va. Tech, Blacksburg, Va. 24061-0346. Phytate (myo-inositol hexakisphosphate) is the major storage form of phosphorus in soybean [*Glycine max* (L.) Merr.] seeds. Non-ruminant animals such as poultry and swine are unable to efficiently utilize the abundant phytate phosphorus in soy-based feed. When manure containing excreted phytate is applied to croplands, it can contribute to increased soil phosphorus levels, resulting in environmental phosphorus pollution. Phytase is an enzyme that hydrolyzes phytate, liberating inorganic phosphate. The addition of commercially available fungal phytase preparations to animal diets facilitates the degradation of phytate. Although phytase supplementation effectively improves phosphorus availability while decreasing phosphorus waste, the cost of phytase enzyme preparations currently limits use. Our goal is to lower phytate content directly in soybean seeds via two different approaches. One project involves the degradation of phytate through phytase gene engineering. The specific objective of the second project is to utilize an antisense strategy to decrease phytate synthesis through modification of genes in the biosynthetic pathway.

FRESHWATER SHRIMP, HYBRID STRIPED BASS AND CHANNEL CATFISH MONOCULTURES VS. THEIR POLY CULTURE COMBINATIONS. A COMPARISON OF TOTAL LIPIDS AND CRUDE PROTEIN IN FINGERLINGS. Rod Hollowell, Brian Nerrie and Debra Prior, Agriculture Research Station, Virginia State University, Petersburg, Va. 23806. An experiment was conducted over a four year period using freshwater shrimp (*Macrobrachium rosenbergii*), hybrid striped bass (*Morone chrysops* x *Morone saxatilis*), and channel catfish (*Ictalurus punctatus*) raised in monoculture and polyculture pond treatments. The poly treatments were Sh-HSB, Sh-CC, HSB-CC and Sh-HSB-CC. The fish were raised on a 5% feed rate using a commercially available (8% lipid and 38% protein) feed and the shrimp received no dietary rations. In a comparison of the total lipids or crude protein levels contained in the whole body analysis, no significant differences were found in the fingerling years when mono species were compared to a like species used in a poly treatment.

CONSTRUCTION OF A MODIFIED GFP PLASMID FOR SUBCELLULAR LOCALIZATION STUDIES IN SOYBEANS. Janice E. Matheson, Regina W. Hanlon, and Elizabeth. A. Grabau, Dept. of Plant Pathology, Physiology and Weed Science, Virginia Tech. The gene for the green fluorescent protein (GFP) from the jellyfish *Aequorea victoria* is being modified to contain a C-terminal vacuolar targeting signal (VTS) from barley lectin. The GFP reporter gene was amplified by the polymerase chain reaction (PCR) to generate flanking KpnI and SalI restriction enzyme sites for cloning purposes. A BglII site was also included near the 3' end of the GFP sequence during the PCR amplification to facilitate the addition of the VTS. The amplified GFP product was digested with KpnI and SalI and inserted into a previously constructed soybean transformation vector under control of a dual-enhanced cauliflower mosaic virus 35S promoter. After plasmid transformation and selection of colonies, plasmid DNA was isolated and sequenced to verify the correct GFP sequence and insertion sites. PCR was used to amplify the coding sequence for the 16 amino acid VTS containing BamHI restriction sites. The VTS sequence will be inserted into the BglII site of the GFP plasmid. Constructs with and without the VTS will be compared for the ability to direct appropriate protein localization when introduced into soybean.

THE ROLE OF SOYBEAN PHYTOCHEMICALS IN CONTROLLING HYPERCHOLESTEROLEMIA AND HYPERPLASIA IN RABBITS. Ali Mohamed, Agricultural Research Station, Virginia State University, Petersburg, VA 23806 and A. Abd El-Fattah and S. Gao, Department of Surgery, Medical College of Virginia, VA Commonwealth Univ., Richmond, VA. 23298. Coronary heart disease (CHD) remains the primary killer of adults in the United States. An elevated blood cholesterol level has been implicated as a major contributing factor in the development of atherosclerosis. In 1992, there were over 300,000 angioplasties performed in the United State. Angioplasty patients often develop new lesions at the angioplasty site. Post-angioplasty restenosis develops in 30% to 50% of the individuals who undergo this procedure, posing an important clinical problem with significant impact on morbidity and mortality. Soyfoods may play an important role in reducing the risk of restenosis. In the United States, less than 2% of the soybean are used for food manufacturing and limited number of soyfood products are consumed at the dinner table. Using rabbit as a model and diets containing different soybean seed fractions, this study showed significant reduction in blood cholesterol in hypercholesterolemic rabbits with possible reduction in arterial wall damage. Studies on the mechanism by which isoflavones and soy proteins affect cholesterol homeostasis and restoration of arterial walls are in progress.

CONCERNS AND PROBLEMS FACED BY FRESHWATER AQUACULTURE PRODUCERS IN VIRGINIA. Scott H. Newton, Cooperative Extension, Virginia State University, Petersburg, VA 23806 and Jim Lawson, Virginia Agricultural Statistics Service, Richmond, VA 23218. Aquaculture is an agricultural industry that is expanding rapidly in Virginia in both freshwater and marine areas. However, in order for industry to fully take advantage of its opportunities, initial concerns were identified and recommendations made in the 1995 Virginia Aquaculture Plan. During the 1990s, the Virginia Agricultural Statistics Service conducted three statewide aquaculture industry surveys and produced a production and economic Report for the years 1993, 1995, and 1997. Besides the information provided for these Reports, approximately 25 percent of the survey responses had additional comments. These anonymous comments from each survey have been reviewed to determine areas of industry concern and opportunities; and categorized to aid the Aquaculture Advisory Board, industry associations, and government agencies to further assist with aquaculture industry growth and development in the Commonwealth.

EFFECT OF FORAGE BASE IN DIET AND SEX CLASS ON GROWTH CHARACTERISTICS AND CARCASS TRAITS IN SPANISH GOATS. Yvonne L. Nutall and S. Wildeus, Agricultural Res. Station, Va. State Univ., Petersburg, Va. 23806. The effect of alfalfa and grass hay-based diets on growth rate and carcass characteristics was evaluated in Spanish goats. Animals represented 8 female and 16 male, late fall-born kids, 8 of which were surgically castrated at 6 mo of age. At 7 mo of age kids were allocated to a 2 (diet)  $\times$  3 (sex class) factorial design, with 4 animals per pen. Diets consisted of chopped hay, supplemented with a corn/soybean meal mixture (16% crude protein) at 1.5% of body weight and free choice complete mineral. After 102 d, animals were fasted overnight, shrunk body weight was determined and animals slaughtered. Carcass weight, dressing %, ribeye area, back fat, kidney and pelvic fat, as well as retail cuts (shoulder, rack, loin, and leg) were determined. Data were analyzed using the GLM procedure of SAS for forage base and sex class as main effects. Alfalfa and grass hay contained 16.8 and 9.4% crude protein, 47.3 and 39.2% ADF, and 64.3 and 71.3% NDF, and had an *in vitro* organic matter digestibility of 45.8 and 38.4%, respectively. Average daily gain was higher ( $P < .001$ ) on alfalfa (137 g/d) than grass hay diets (78 g/d), but was not affected by sex class. Carcass weight and dressing % were higher ( $P < .01$ ) on alfalfa (33 kg and 52.8%) than grass diets (27.9 kg and 50.3%), respectively, but were not affected by sex class. Adjusted ribeye area was smaller in alfalfa than grass hay diets (0.312 vs. 0.347 cm<sup>2</sup>/kg), and higher ( $P < .05$ ) in wethers than bucks (0.355 vs. 0.307 cm<sup>2</sup>/kg), with does intermediate (0.327 cm<sup>2</sup>/kg). Back fat, and pelvic and kidney fat were lower ( $P < .05$ ) in bucks (0.12 cm and 1.8%), than does (0.17 cm and 5.7 %) and wethers (0.22 cm and 4.0%). The portion of shoulder (42.6%) was higher, but loin (11.9%) and leg (29.5%) lower in bucks, than in does and wethers. Data indicate that the quality of the forage base had a greater impact on growth and carcass yield, whereas sex class primarily influenced carcass fat content.

EFFECTS OF POLYCULTURE ON HYBRID STRIPED BASS AND CHANNEL CATFISH FINGERLING PRODUCTION. Debra E. Prior, Brian Nerrie and Rod Hollowell, Agriculture Research Station, VSU, Petersburg, VA. 23806. A polyculture experiment was conducted to evaluate the potential of culturing hybrid striped bass (HSB), channel catfish (CCAT), and freshwater shrimp (SHR) in various combinations. ANOVA showed that HSB individual final weight (IFW) was significantly greater ( $P \leq 0.08$ ) when cultured with CCAT fingerlings. Growth per day (GPD), feed conversion rate (FCR), species net production (SNP) and survival (SURV) of HSB were not significantly effected by culture strategy. The harvested HSB population distribution pattern indicated only 2.8% were saleable as stocker grade fish when cultured without CCAT's, whereas 43.6% were stocker grade fish when raised with CCAT's. Survival and IFW of CCAT fingerlings were not influenced by culture strategy. However, GPD, FCR and NSP of CCAT's were significantly better ( $P \leq 0.05$ , 0.007, 0.05, respectively) when cultured without HSB. All CCAT raised without HSB were saleable as stocker grade fish, whereas 95.8% of CCAT's were stocker grade fish when raised with HSB fingerlings.

DRIED PITCHER PLANT LEAVES AS FLORAL DECORATIONS. Philip Sheridan and Pat Bingham\*. Meadowview Biological Research Station, Woodford, VA 22580. The white-topped pitcher plant, *Sarracenia leucophylla* Raf., is both a popular fresh cut and dried leaf in the floral trade bringing up to \$1.00 a leaf. We had seen dried leaves of this species but were not satisfied with the quality due to shrinking and distortion of the pitcher in the drying process. We harvested mature fall leaves of this species and used a sand drying method to maintain the shape of the pitcher. Leaves were filled with quarried sand, placed horizontally on a sand bed and then covered with sand. The whole assembly was then dried in a greenhouse. After one month leaves were removed from the sand, cleaned, and sprayed with a floral sealer and protectant. Leaves maintained both color and shape and demonstrated that an increase in the quality of this product is possible. Pitcher plants therefore may be grown in Virginia for both the fresh-cut and dried flower trade.

COLLECTION, GERMINATION, AND PROPAGATION OF VIRGINIA LONGLEAF PINE. Philip Sheridan, Nancy Penick\*, Anne Simpson\*, and Peter Watkinson\*. Meadowview Research Station, Woodford, VA 22580. A stand of longleaf pine in Suffolk County, Virginia was visited November 3-14, 1997 and mature cones gathered by clipping the tips of branches with an extension pole. Two thousand six hundred fourteen seeds were obtained from 121 cones with an average yield of 21 seeds per cone. One thousand seven hundred forty eight seeds were used in an experiment to determine whether hydrogen peroxide would provide significantly greater germination than controls. Seeds were sown in greenhouse beds in mid-December and covered to a depth of 1/4 inch with soil. Germination commenced within one week and by the end of January there was no significant difference between the treatments with germination averaging 52%.

A CENSUS OF LONGLEAF PINE IN VIRGINIA. Philip Sheridan<sup>1</sup>, John Scrivani<sup>2</sup>, Nancy Penick<sup>3\*</sup>, and Anne Simpson\*. <sup>1</sup>Meadowview Biological Research Station and <sup>2</sup>the Dept. of Forestry, Woodford, VA 22580. Longleaf pine is a fire resistant southern pine which reaches its northern limit in southeastern Virginia. Longleaf pine has experienced a drastic reduction in acreage and a census was conducted to determine the number of trees left in Virginia. Four thousand four hundred thirty two trees and 122 seedlings were counted in three counties. Most trees ranged in diameter between 4 and 8 inches with the champion tree recorded in Suffolk County at 26 inches. Longleaf pine is both a commercially valuable tree and a major component of southeastern fire maintained forest ecosystems. Since remaining longleaf pine stands in Virginia represent only a fraction of the estimated original 1.8 million acres we recommend a restoration and reforestation effort within this trees historic range.

CHARACTERISTICS OF THE PREPUBERTAL TESTIS AND EPIDIDYMS OF THE GOAT. S. Wildeus and Torri D. Wilson. Agricultural Res. Station, Va. State Univ., Petersburg, Va. 23806. Reproductive tract organ weights and histomorphometric dimension were evaluated in 10 prepubertal Spanish bucklings, recruited from a spring-born kid crop, weaned at 8 weeks of age, and fed for moderate growth. Animals were surgically castrated at either 4 (n=5) or 5 mo (n=5) of age, after determination of body weight (BW) and scrotal circumference (SC). Following castration, testicular weight and dimensions, and segmented epididymal weights were recorded. Parts of testicular parenchyma, and caput and cauda epididymis were fixed and processed for histology (H+E staining) to determine seminiferous and epididymal tubule diameter and epithelial height. Data were analyzed for differences between age groups on a whole animal basis. Correlation coefficients were determined for combined age groups. BW tended (P=.067) to be and SC was higher (P<.05) at 5 mo (15.1 kg and 16.2 cm) than 4 mo (12.1 kg and 12.6 cm) of age, whereas the SC to BW ratio was similar for the two age groups. Testis weight increased from 30.5 to 58.1 g (P=0.68) and epididymal weight from 2.99 to 6.73 g (P<.05) between 4 and 5 mo of age. Epididymal weight change from 4 to 5 mo was most pronounced in the caput (1.14 to 3.37 g; P<.05). Seminiferous tubule diameter increased (P<.05) from 116 to 159  $\mu$ m, but tubules were patent in only 3/5 (36.8  $\mu$ m epithelial height) and 4/5 (48.0  $\mu$ m epithelial height) of the testes at 4 and 5 mo of age, respectively. Age differences in epididymal tubular dimensions were only observed in caput tubule diameter (91 vs. 157  $\mu$ m; P=.071). Testis and epididymal weights and dimensions were highly correlated with BW (r>.80; P<.01) and SC (r>.95; P<.001), but not age. SC was correlated (r=.97; P<.001) with seminiferous tubule diameter. These data indicate that seminiferous tubules achieved patency by 5 mo of age and that bucks would thus not be suited for use in multi-doe breeding systems at this stage of development.

RESPONSE TO SEMEN COLLECTION BY ARTIFICIAL VAGINA IN FIVE BREEDS OF GOATS. S. Wildeus<sup>1</sup>, Joni Rae Collins<sup>1</sup>, and J.-M. Luginbuhl<sup>2\*</sup>, <sup>1</sup>Agricultural Res. Station, Va. State Univ., Petersburg, VA 23806 and <sup>2</sup>Dept. of Anim. and Crop Science, N.C. State Univ., Raleigh, NC 27695. As part of a project to characterize reproductive function in different breeds of meat-type goats, we evaluated the training response of bucks to semen collection by artificial vagina during the non-breeding season (February). The experiment used six mixed-aged bucks each of the Boer, Myotonic, Nubian, Pygmy and Spanish breeds. Bucks were placed as a group adjacent to two estrogen-treated ovariectomized does and allowed to observe mounting activity prior to collection. For testing, bucks were placed up to 15 min in the pen with the teaser does and semen was collected by the same operator. Two collections were performed on each buck 7 d apart. Collection parameters recorded included: body weight, scrotal circumference, rank order on day of collection, choice of doe, time to first mount with ejaculation, and number of false mounts. Following a successful first mount, choice of doe, time to mount and false mounts were recorded for a second mount within the 15 min test period. Body weight ranged ( $P < .01$ ) from 71.7 kg in Boer bucks to 32.2 kg in Pygmy bucks. Scrotal circumference was again higher ( $P < .05$ ) in Boer bucks (28.4 cm), than in the other breeds ( $< 24.0$  cm); however, the scrotal circumference to body weight ratio was higher ( $P < .05$ ) in Pygmy bucks than the other breeds. The number of successful first mounts ranged from 4/6 in Pygmy and Spanish bucks to 2/6 in Boer and Nubian, and 1/6 in Myotonic bucks, and was similar for both collections 7 d apart. Reaction time in bucks mounting was generally  $< 1$  min and increased to 2 - 8 min for the second mount at both collections. The number of false mounts ranged from 0 to 3 and was not affected by breed or collection. Data suggest some differences between breeds in collection ease, but there was generally a poor training response to semen collection by artificial vagina during the non-breeding season.

SPERM PRODUCTION AND TESTICULAR HISTOLOGY IN MEAT-TYPE GOATS FOLLOWING DIETARY INCLUSION OF WHOLE COTTONSEED. S. Wildeus<sup>1</sup>, J.-M. Luginbuhl<sup>2\*\*</sup> and M.H. Poore<sup>3\*</sup>, <sup>1</sup>Agricultural Res. Station, Va. State Univ., Petersburg, VA 23806 and <sup>2</sup>Dept. of Crop Science and <sup>3</sup>Animal Science, N.C. State Univ., Raleigh, NC 27695. Cottonseed by-products, containing gossypol, have been implicated in impaired male reproductive function when fed to livestock. In this experiment testicular and epididymal histology and sperm reserves were evaluated in 16 young male goats (*Capra hircus*) following a 105 d feeding period of orchardgrass hay and four levels of whole cottonseed (WCS): 0, 8, 16, and 24% ( $n=4$ /diet), estimated to provide 0 to 75 mg/kg/day free gossypol. At slaughter, scrotal content was recovered and testicular and segmented epididymal weights were recorded. The right side of the tract was stored frozen for tissue homogenization, and the left side processed for histology (Bouin's fixative, H+E staining). Differences between WCS levels on histomorphometric measures (tubular diameter and epithelial height) and sperm reserves were determined by analysis of variance. One animal from the 0% group was excluded from analysis due to testicular hypoplasia. Total testis weight (153.1 g) and epididymal weight (22.2 g), as well as segmented weights (caput: 11.4 g, corpus: 3.0, and cauda: 7.8 g) were not affected by WCS level. Seminiferous tubule diameter averaged 161  $\mu$ m, and epithelial height 66.4  $\mu$ m and were also not affected by WCS level. Epididymal tubular diameter ranged from 359  $\mu$ m in the efferent ducts to 401  $\mu$ m in the corpus, and tubule diameter decreased from the proximal (efferent duct: 95.2  $\mu$ m) to the distal region (cauda: 30.8  $\mu$ m), but was not affected by WCS level. Testicular sperm production ( $18.8 \times 10^7$ ) and reserves ( $2.70 \times 10^9$ ), as well as caput ( $2.25 \times 10^9$ ), corpus ( $1.13 \times 10^9$ ), and cauda ( $8.39 \times 10^8$ ) reserves were not affected by diet. These data indicate that WCS, at levels of up to 24% of total diet, apparently had no effect on seminiferous tubular morphology and sperm reserves in these young male goats.

USE OF VEGETABLE SOYBEAN BIOMASS AS A FORAGE SOURCE FOR GOATS. S. Wildeus<sup>1</sup>, T. Mebrahtu<sup>1</sup>, and W. F. Brown<sup>2\*</sup>, <sup>1</sup>Agricultural Res. Station, Va. State Univ., Petersburg, Va. 23806 and <sup>2</sup>Inst. of Food and Agricultural Sciences, Univ. of Florida, Ona, FL 33865. A pilot trial was completed to assess the utilization of vegetable-type soybean biomass (SB) by goats. Intact yearling crossbred bucks ( $n=15$ ; average body weight: 27 kg) were allocated at random to be fed SB of three genotypes (Late Giant, D71-9806, and PI506852), harvested at the green pod stage (R6-R7). Following removal of pods, whole SB was air-dried and manually chopped to 10-15 cm lengths. Genotypes were analyzed for nutritional quality. For the feeding trial, animals were placed into 2.5 x 3.0 m individual pens and allowed to adjust to the pens over 3 d while being fed an all hay diet. SB was fed in quantities to ensure *ad libitum* access in 115 L plastic garbage cans, modified with key hole feeders, without further supplement apart from mineral mix. Animals were fed at 0900 h and the previous day's refusal was weighed back at this time. Due to the limited availability of SB the trial was terminated after 4 d. Crude protein in SB ranged from 9.96, 9.78 to 7.27% in Late Giant, D71-9806, and PI506852, respectively, and IVOMD was numerically higher in Late Giant (55.6%) and D71-9806 (50.3%) than in PI506852 (43.8%). NDF was 55.4, 58.6, and 65.2%, and ADF 44.1, 45.4, and 52.1% in Late Giant, D71-9806, and PI506852, respectively. This would suggest a lower feeding value of PI506852, but it is not clear if this difference is inherent to this variety or the result of a 4 d delayed harvest. Consumption of SB by goats ranged from 875 and 798 to 712 g/d for Late Giant, D71-9806, and PI506852, respectively, with intakes of 72.5, 66.3, and 62.4 g/kg metabolic body weight ( $\text{kg}^{0.75}$ ). These differences in intake were not statistically significant ( $P > 0.10$ ), but reflect *in vitro* forage quality values. Data indicate that SB is of moderate nutritional quality as a forage source, and is readily consumed by goats. Further research is warranted to evaluate growth performance on SB-based diets.



## Archaeology

*No abstracts submitted*

## Astronomy, Mathematics and Physics

### THE APPLICATION OF LABVIEW FOR MEASURING THE HALL EFFECT IN SEMICONDUCTORS.

Dan Beckstrom, Wm. Christopher Hughes, Dept. of Physics, James Madison University, Harrisonburg, VA 22807. A LabView-based system has been assembled for the acquisition of Hall Effect data from semiconductor samples using the Van der Pauw technique. This system includes a sample mount with a spring-loaded bayonet probes to make contact to samples of various sizes for four-point probe measurements. This sample mount is placed between the poles of a 5 kG electromagnet and connected to a Keithley 220 current source and Keithley 2000 digital multimeter for measurement of potential differences between two contact when a known current is run through the other two contacts. A Dell PC running National Instruments' LabView is used to acquire these voltages and analyze them to determine the resistivity, carrier concentration, type, and mobility of the sample under study. These measurements will be used to analyze samples of GaN implanted with Si and Mg to determine the efficiency of the implantation process in producing high quality p- and n-type regions.

SCO X-1: DISTANCE AND STRUCTURE EVOLUTION. Barry Geldzahler & Charles Bradshaw, Inst. for Computational Sciences and Informatics, George Mason Univ., Fairfax, VA, 22031, & Edward Fomalont, National Radio Astronomy Observatory, Charlottesville, VA 22903. We present the results of high resolution radio frequency studies of the galactic binary star system Sco X-1. We tie together the results of 18 years of observations into a coherent picture describing flux density variability, astrometry, and structural evolution. The latest results indicate structural variations similar to the dual opposing beams seen in quasars and active galactic nuclei. The new-born components move away from Sco X-1 at speeds of about 0.3 c, comparable to the speeds seen in SS433 and Cyg X-3, suggesting a common acceleration mechanism and common systemic properties.

### ACCURACY OF KERNEL APPROXIMATION IN 3-DIMENSIONAL SMOOTHED PARTICLE HYDRODYNAMICS.

Aamer Haque and John Wallin, Inst. for Computational Science and Informatics, George Mason Univ., Fairfax, VA 22030. Smoothed particle hydrodynamics is a Lagrangian method for numerically solving problems in hydrodynamics. The method uses kernel interpolation to calculate the values of the field variables. The accuracy of the kernel approximation in calculating density and density gradient is investigated in the three-dimensional case. The computer program used for this investigation is described in detail. This program is run with particles that are arranged in regular and perturbed lattices. Comparisons are made between the Gaussian and spline kernels. Several parameters of kernel approximation are explored and the results summarized.

### SMOOTH SOLUTIONS OF KLEIN-GORDON EQUATION AS ELEMENTS OF AN ANISOTROPIC SPACE OF TEST FUNCTIONS.

Domenico Napolitani, Daniele C. Strupps, Dept. of Math, George Mason Univ., Fairfax, VA, 22030, & C. A. Berenstein, Institute for System Research, Univ. of Maryland, College Park, MD 20742. We show that the so-called Generalized Fourier Hyperfunctions can be a suitable choice as test-function space in Quantum Field Theory, and we apply a specific case of our theory to the problem of growth conditions of solutions of the Klein-Gordon equation.

A PLASMA-AIDED ANNEALING FURNACE FOR PROCESSING OF III-V NITRIDE SEMICONDUCTORS. Russ Neufeld, Wm. Christopher Hughes, Dept. of Physics, James Madison University, Harrisonburg, VA 22807. In order to activate dopants in wide-gap III-V nitride semiconductors after ion implantation and remove implantation damage, a high temperature anneal must be performed. Recent experiments at other laboratories have shown that annealing at 1000-1050°C is inadequate to fully activate the dopants. However, at higher temperatures the material begins to decompose. To avoid decomposition, we propose using an atomic nitrogen ambient. To do this, we have designed and assembled a plasma-aided annealing furnace which consists of a vacuum capable tube furnace with a radio frequency (RF) power supply and coil to generate an inductively coupled plasma. The system is pumped using a turbomolecular drag pump to achieve pressures as low as  $10^{-6}$ - $10^{-7}$  Torr. Nitrogen can be leaked through a needle valve to raise the pressure to over 1 mTorr before creating a plasma using the RF power supply. The RF supply is connected to a nichrome wire coil, which is wrapped directly around the furnace tube. The wire coil creates a rapid and powerful flux within the pipe, essentially vibrating the  $N_2$  molecules apart to form atomic nitrogen and  $N^+$  ions. The furnace raises the ambient temperature within the pipe (where the sample is placed) to  $\sim 1000$  °C. An additional tungsten heater is wrapped around the sample inside the pipe, bringing the sample temperature to the 1100-1500°C required for the annealing process. Preliminary tests of the plasma and sample heater are in progress with initial sample annealing planned to start in early summer 1998.

MINORITY PHYSICIST ARCHIVE. George Ofori-Boadu & Dvynthia Keppel, Dept. of Physics, Hampton Univ., Hampton, VA 23668. With support from the American Physical Society, the Hampton University chapter of the Society of Physics Students has embarked on a project to create a Minority Physicist Archive centered around a World-Wide-Web home page. The goal of this page is to be a resource for anyone interested in the lives and works of minority physicists. It is hoped that the archive will serve as a valuable educational tool for students and educators, both as a resource and as an inspiration. This home page may be visited currently at <http://phv.hamptonu.edu/sps/sps.htm>. The archive features Edward Bouchet Award winners, Fellows of the American Physical Society, and historical figures. We are currently gathering information regarding historical figures for the archive. If you are interested in nominating yourself or a person with great achievements to be included in this page, please send a brief biography of the person to Dr. Cynthia Keppel, Dept. of Physics, Hampton Univ., Hampton, VA 23668.

ELECTRONIC GROUNDS STATES AND EIGENVECTORS OF MEGA DIMENSIONAL MATRICES. Walter P. Opaska, James Madison University Physics Department, J. Gubernatis\*, Los Alamos Laboratory. Physical properties such as magnetism, metallic conduction, quantum hall effect, and superconductivity constitute phenomena which results from the non-trivial correlation between interacting electrons. Calculation of the state energy and wave function of models of quantum particles, which are the lowest eigenvalue and eigenvector of the Hamiltonian matrix, are essential for their study. Typically, this matrix is too large for standard (EISPACK) routines. Instead, I implemented a Lanczos method, which allows the calculation of the eigenvalues and eigenvectors of a large, sparse, hermetian matrix at a fraction of the memory cost of conventional methods. A parallel version was developed to study even larger electron systems.

THE COMPTON PROFILE OF EXCITED LI<sup>7</sup>. Christopher Overall, Dept. of Physics, James Madison University, Dr. Brett DiPaula\*, Dept. of Physics, Kansas State University. During the summer of 1997, I participated in an REU summer program at the J.R. MacDonald Atomic Physics Laboratory located at Kansas State University. There I worked on an experiment designed to find the Compton profile of lithium in an excited quantum state. The gaseous lithium sample was excited from the (2s) state to the (2p) state by striking the sample with laser light from a red diode laser. We first developed a miniature "quantum state" gauge with an optical setup consisting of a lithium discharge tube that produced the necessary lithium gas as well as the laser and other optical equipment. Using this small-scale version, we were able to develop a methodology for consistently achieving and maintaining the 2p state of lithium. Once this was accomplished, we built a large-scale lithium oven that was placed on the end of a beam line of one of the accelerators in the lab. By splitting the laser beam into both the gauge and the lithium oven, we were able to monitor and maintain the state of the lithium in the oven. Then by striking the lithium target with an ion beam, we were able to measure the Compton profile of lithium in the 2p state.

#### ANALYSIS OF A PLASMA TREE CODE: SHORT- VERSUS LONG-RANGE FORCES.

Gary L. Page, J. Waltz, S. D. Milder, and J. Wallin, Institute for Computational Sciences and Informatics, George Mason University, Fairfax, VA 22030. Attempts to investigate plasma behavior with computer models have generally dealt with high level hydrodynamic models or low-level N-particle codes. The predominant N-body methodology in plasma work has been the Particle-In-Cell (PIC) models. Although powerful, PIC codes have the drawback that they do not perform well with strongly nonuniform particle distributions, correlated systems, or complex geometries. In astrophysics, on the other hand, tree codes are often used to gain insight into the relevant N-body problems. Tree models represent particles individually and provide their benefits by increasing the efficiency with which inter-particle forces can be calculated. This work focuses on two tree algorithms: K-D trees and Barnes-Hut trees. The former is taller (more generations) and narrower (each node has only two children); the latter a shorter, wider structure. This poster presentation compares the two tree algorithms to assess their performance and characteristics in addressing simulations with both short- and long-range inter-particle forces. Conclusions regarding the benefits of each approach are offered, along with insights as to the appropriate regimes of applicability of each method.

#### OVERCONVERGENCE PHENOMENA FOR DIRICHLET SERIES. Daniele C. Struppa.

Department of Mathematical Sciences, George Mason University, Fairfax, VA 22030. The overconvergence phenomenon for Taylor series is well known. It can be described as follows: under suitable conditions a Taylor series can converge in a region beyond its radius of convergence, provided that its terms are suitably grouped (which amounts to making a request on the convergence of a specific subsequence of the sequence of partial sums). Since Taylor series are a special case of Dirichlet series, one may wonder whether similar results are available for more general Dirichlet series. Some work in this direction was done by V. Bernstein in the twenties. In this paper (joint work with Takahiro Kawai, from RIMS of Kyoto University) I will show that the theory of infinite order differential equations allows us to prove a similar result at least for a special class of Dirichlet series. I will also show how these methods carry over to the case of several variables, thus presenting a completely new result for that case.

GUTS THAT TCL - THE ONGOING DEVELOPMENT AND INSTALLATION OF A REMOTE COMPUTER CONTROLLED CALIBRATION SYSTEM AT THE JEFFERSON LAB. Justin Voshell, Dr. Kevin Giovanetti, Department of Physics, James Madison University, Harrisonburg, Virginia. For the past several years a JMU research group has been developing and constructing a calibration system for the forward calorimeters on the CLAS detector in Hall B at Jefferson Lab in Newport News. The 'final act' of this project is the installation of the system and the creation of software routines that allow the end user to control the system from some remote location [either at the lab or across the internet]. I will summarize the status of this part of the project.

MONTE CARLO SIMULATION OF WATER. Jacob Waltz & Estela Blaisten-Barojas, Inst. for Computational Sciences and Informatics, George Mason Univ., Fairfax, VA, 22031. A Monte Carlo simulation of liquid water is presented. The system studied is composed of 216 molecules in the canonical ensemble at room temperature. The intermolecular potential used is a single-site potential which includes dipole-dipole interactions, tetrahedral terms to represent the coordination shells, and a Leonard-Jones term to account for excluded volume effects. The structural and energetic properties of the model liquid water are compared to experiment. Ewald corrections are used to calculate the dielectric constant. Additional results include a study of the ice structure.

## Biology

p53 MEDIATED APOPTOSIS IN ME-180 CERVICAL CARCINOMA CELLS. Tara L. Barto and Rosemary Barra, Dept. of Biological Sciences, Mary Washington College, Fredericksburg, VA. The tumor suppressor gene p53 normally functions to control cellular proliferation. It regulates the transcription of a variety of cell replicative associated genes and it can block cells near the G1/S transition in the cell cycle. In addition to its anti-proliferative effects, p53 plays a role in the induction of apoptosis following DNA damage by activating endonucleases that cause DNA fragmentation. This in turn activates a cascade of reactions resulting in the apoptotic death of the cell. The purpose of this experiment was to determine the concentration of cyclophosphamide that triggers apoptosis in ME-180 cervical carcinoma cells. Results from the Klenow FragEL DNA Fragmentation Assay indicated that 0.025 ug/ml cyclophosphamide induced an apoptotic response in ME-180 cells.

IMPACTS OF FESCUE HAYFIELD CONVERSION TO NATIVE WARM SEASON GRASSES ON SMALL MAMMAL POPULATIONS. Salvatore J. Fiorenza III, Deana Carlson \*, Christina Long \*, Kevin Caudle \*, Michael T. Mengak, Environmental Science Program, Ferrum College, Ferrum, Virginia 24088 (address correspondence to MTM). Native warm season grasses are thought to provide better habitat for quail (Colinus virginianus) and several species of grassland birds and herbivorous small mammals. This project investigated the effect of converting an existing fescue (Festuca arundinacea) hayfield to switchgrass (Panicum virgatum) hay. The study was conducted on the George Washington National Forest at Hidden Valley in Bath County, Virginia. A single live-trapping grid was established and trapped in both the switchgrass (treatment) and fescue (control) field in March 1997. The treatment field was treated with the herbicide *Roundup* in July 1997 and burned and seeded to switchgrass in the same month. Live trapping continued at 60-day intervals from March 1997 until May 1998 except in January 1998. Animals were toe-clipped and released at the site of capture. In the treatment field, 22 individuals of 2 species (Microtus pennsylvanicus and Peromyscus leucopus) were caught in 1603 trap nights. In the control field, 6 individuals of 3 species (M. pennsylvanicus, P. leucopus, and Blarina brevicauda) were caught in 1539 trap nights. The overall capture index was 0.137 animals per 10 trap nights and 0.039 animals per 10 trap nights in the treatment and control fields, respectively. Vegetation from each field was clipped, bagged separately, dried and weighed in April 1998. The treatment field had a mean biomass weight of 58.24 grams per meter<sup>2</sup> and the control field had a mean biomass weight of 38.41 grams per

EFFECT OF TREATMENT WITH INTERLEUKIN-2 AND LIPOPOLYSACCHARIDE ON FREQUENCY OF PREGNANCY LOSS IN CD-1 MICE. T. P. Gans and A. F. Conway, Dept. of Biol., Randolph-Macon Col., Ashland, Va., 23005, and C. M. Conway, Dept. of Biol., Va. Commonwealth Univ., Richmond, Va. 23284-2012. The combined effects of lipopolysaccharide (LPS) and recombinant murine interleukin-2 (IL-2) on frequency of pregnancy loss were investigated in CD-1 mice. Pregnant females were injected intraperitoneally with 0.5  $\mu\text{g}$  of IL-2 on days 7 and 9 of gestation (plug = day 1), and injected intravenously with 2  $\mu\text{g}$  of LPS on day 9 of gestation. Control females were injected with phosphate-buffered saline (PBS) in place of IL-2 and/or LPS. Females were sacrificed on day 12 and the reproductive tract, spleen, and dorsal lymph nodes were evaluated. IL-2 treatment significantly increased frequency of pregnancy loss and weight of the spleen in LPS-treated females but had no effect alone. Body weight loss in response to LPS treatment was not altered by IL-2 treatment. These results indicate that the mechanisms leading to pregnancy loss and splenic enlargement are somewhat independent from mechanisms leading to body weight loss, since they reacted differently to IL-2. These results further suggest that viral or bacterial infections which lead to IL-2 secretion may significantly increase the risk of pregnancy loss induced by Gram-negative bacterial infections which release LPS.

SEX RATIOS OF EMERGENT COTTON STAINER INSECTS (*DYSDERCUS ANDREAE*) IN A LAB-REARED COLONY. Harold J. Grau, Dept. of Biol., Chem., & Env. Sci., Christopher Newport Univ., Newport News, VA 23606. St. Andrew's cotton stainer (*Dysdercus andreae*) is one species of a pantropical group of Pyrrhocorid bugs that feed predominantly on seeds of the plant order Malvales. These bugs exhibit prolonged copulation, generally believed to be a mating strategy in response to the male-biased sex ratio that is typically found in wild populations. Why there is such a sex ratio among adults is not known. To determine if this is due to causes that are in effect before or after emergence of nymphs to the adult stage, the gender of newly emerged adults in a laboratory population has been regularly recorded since May of 1995. Nearly 1300 new adults were recruited into the colony during the past three years; of these, over 47% emerged as females (not significantly different from the 50% expected by a random assortative sex determination process). However, the sex ratio of surviving adults, recorded at various intervals, has been significantly male-biased, most likely because males live longer (approx. 9 - 10 weeks) on average than females (5 - 6 weeks).

REINTRODUCTION OF A MALE SILVERBACK LOWLAND GORILLA INTO A SOCIAL GROUP. Tara R. Harris, New Century College, George Mason University, Fairfax, Va. 22030. The National Zoo in Washington, D.C. reintroduced a silverback male gorilla into a social group to allow the genetically underrepresented male a chance to reproduce. This study examined the changes in behavior associated with the reintroduction. The silverback male achieved dominant status quickly when introduced to a juvenile male but did not achieve dominant status within the larger group of five gorillas after two months of socialization. The silverback male showed a significant increase in solitary behavior after his reintroduction as well as a significant decrease in feeding/foraging and significant increase in the dominance/aggressive display "push/flail object." An adult female gorilla also showed a significant increase in solitary behavior and significant decrease in feeding/foraging. An infant male showed a significant decrease in social play and a juvenile female showed a significant decrease in feeding/foraging and a significant increase in proximity to other gorillas. No mating behavior was observed after the silverback's reintroduction and the silverback showed both submissive and dominance displays while with the group. The silverback's difficulty in obtaining dominant status within this group can be attributed to his inexperience as a group leader, his familiarity with the females in the group, and his unusual personality. Suggestions for future introductions include introducing inexperienced silverbacks to small groups at first, introducing unfamiliar females to silverbacks, and taking into account the personalities of each gorilla when determining which gorillas to introduce.

ANOXYGENIC, PHOTOSYNTHETIC CHROMATIACEAE IN TARPON BLUE HOLE, ANDROS ISLAND, THE BAHAMAS. R. B. Jonas, K. Marano Briggs, Dept. of Biol., George Mason Univ., Fairfax, VA, 22030, D. Ringelberg\*, Dyntel Corp., Waterways Experiment Station, Vicksburg, MS, and D. J. Ellis\*, Smithsonian Inst., Nat. Museum of Natural History, Washington, D.C. The salinity stratified water column of Tarpon Blue Hole, Andros Island, the Bahamas, contains a dense red zone (red layer) of bacteria in the upper portion of the anoxic, sulfidic subpycnocline. Tarpon Blue Hole, a karst feature of Stafford Creek estuary, is approximately 6.5 m deep with a surface salinity ranging from near zero to 16 ppt, but with a bottom salinity of 23 ppt or greater. This salinity stratification results in the isolated, anoxic subpycnocline layer. The oxygen concentration at approximately 0.1 m is near saturation while the deeper layers are anoxic, sulfidic and highly reducing. Temperatures of 41°C have been observed near the pycnocline, and hydrogen sulfide concentrations reach 3.5 mM near the bottom. The morphology of a large proportion of the bacteria is characteristic of members of the Chromatiaceae, a family of photosynthetic sulfur oxidizers. These cells are pigmented red, contain sulfur inclusions, and range in size from relatively large, resembling *Chromatium okenii*, to relatively small, resembling *Chromatium venosum*. Sulfur-oxidizing photosynthetic enrichments, including large and small cell Chromatiaceae species, have been successfully established from oxic and anoxic depths in Tarpon Blue Hole. Spectrophotometric results, indicating the presence of bacteriochlorophyll a, and phospholipid fatty acid analyses further support the identification of Chromatiaceae in these enrichments.

DIVERSITY AND DISTRIBUTION OF MICROORGANISMS IN HIGHLY STRATIFIED, EXTREMELY SULFIDIC BAHAMIAN BLUE HOLES. R. B. Jonas, J. Kearns\*, K. Marano Briggs, L. Kristianson\*, Dept. of Biol., George Mason Univ., Fairfax, VA, 22030, T. Bludis\*, J. Tang\*, American Type Culture Collection, Manassas, VA, J. H. Tuttle\*, Univ. of MD, Ctr. For Environmental Studies, Chesapeake Biological Lab., Solomons, MD 22068, and D. J. Ellis\*, Smithsonian Inst., Washington, D.C. Thriving anaerobic microbial communities have recently been discovered in the water columns of anchialine, inland Blue Holes of Andros Island, the Bahamas. Blue Holes are salinity stratified aquatic systems with a lens of fresh water overlying anoxic sea water. The Blue Holes are extremely stable, highly reducing and permanently anoxic in the subpycnocline (generally below about 20 m), and it is generally in this sulfidic subpycnocline that microbial life flourishes. Church's Blue Hole is the most chemically extreme of these systems with the highest hydrogen sulfide concentrations (18 mM in the mid-water) thus far reported for any marine water. In Church's Blue Hole the microbial community established at the pycnocline is so thick that it resembles a stationary phase broth culture. Compared to surface water, total bacterial abundance, as measured by acridine orange direct counts, increases by nearly an order of magnitude beneath the pycnocline. Dissimilatory sulfate-, sulfur-, humics- and Fe(III)-reducing, fermentative and aerobic enrichments have been successfully established from Church's and two other physicochemically distinct Blue Holes, EW-3 and Tarpon. Sulfate- and Fe(III)-reducing enrichments were obtained from dilutions of natural waters as great as 10<sup>-4</sup>. Several enrichments have yielded pure culture isolates. The elevated sulfide concentrations and the abundance of sulfate and sulfur reducers suggest active sulfur cycling within the microbial communities of Bahamian Blue Holes.

C-MYC EXPRESSION IN DIFFERENTIATING HL-60 CELLS. Jennie Y. Lin and Rosemary Barra, Dept. of Biological Sciences, Mary Washington College, Fredericksburg, VA. The regulation of the c-myc oncogene has been known to have a close association with programmed cell death, but its specific function and mechanism of action is still under debate. The objective of this study was to compare the c-myc expression in 12-o-tetra-decanoylphorbol-13-acetate (TPA) induced and dimethylsulfoxide (DMSO) induced HL-60 cells. HL-60 cells were treated with various concentrations of TPA and DMSO to induce differentiation of the monocytic and granulocytic pathways. Significant changes in cellular characteristics were observed in the monocytic differentiation after 24 hours of incubation. The DMSO induced HL-60 cells were incubated for 96, 120, 144 and 168 hours and only slight changes in cell morphology were detected in each time period. The c-myc expression in each cellular preparation was detected by gel electrophoresis and immunoblot techniques. However, the c-myc protein bands were not consistent in size, thus making it impossible to compare the c-myc expression in the TPA and DMSO induced HL-60 cells.

LONG TERM TRENDS IN MICROZOOPLANKTON COMMUNITIES OF THE LOWER CHESAPEAKE BAY. Alicia M. Lo Galbo, Dept. of Biol., Old Dominion Univ., Norfolk, Va. 23529, & K. E. Carpenter, Dept. of Biol., Old Dominion Univ., Norfolk, Va. 23529, & M. F. Lane\*, Applied Marine Res. Lab., Norfolk, Va. 23529. Microzooplankton form a crucial link in the food web of the Chesapeake Bay; thus, long term monitoring of this trophic component proves of extreme importance in assessing ecological conditions in the Chesapeake Bay. Thirteen sites in the Virginia section of the Chesapeake Bay and its major tributaries were sampled from January 1993 to December 1997. Results indicated negative microzooplankton density trends at ten stations while three stations exhibited no significant microzooplankton density trends. Microzooplankton density trends were detected in the cladoceran, copepod nauplii, oligotrich, rotifer, and tintinnid taxonomic categories while no significant trends were revealed in the polychaete larve or sarcodinid groups. All bay stations with significant density trends indicated declines in copepod nauplii densities and two bay stations exhibited declines in the tintinnid taxon group. Tributary stations with significant trends revealed density declines in the copepod nauplii, cladoceran, oligotrich, tintinnid, and rotifer taxonomic categories. Other bay program studies indicated decreasing trends in abundance of picoplankton and mesozooplankton. Taken together with our study, we conclude that some environmental factor(s) may be causing an overall deterioration of microzooplankton communities in the Chesapeake Bay.

COMPARISONS OF TEMPORAL DISPLAY STRUCTURE ACROSS CONTEXTS AND POPULATIONS IN MALE ANOLIS CAROLINENSIS: SIGNAL STABILITY OR LABILITY? Matthew B. Lovern & Thomas A. Jenssen, Dept. of Biol., Virginia Tech, Blacksburg, VA 24061. We examined the relative stability versus lability of temporal display structure in males of the lizard, Anolis carolinensis. We videotaped headbobbing displays across field and laboratory environments, social contexts, and populations for males from Georgia, Florida, and Hawaii, and subsequently generated display-action-pattern (DAP) graphs of these displays for statistical comparison. Anolis carolinensis is known to be a recent (circa 1950) colonizer of Hawaii, and displays from this population could therefore be altered through founder effects, genetic drift, and/or a tropical environment unlike that encountered over the rest of the species' range. Therefore, we expected to find lability in temporal display structure between Hawaiian and mainland populations. In contrast, we found that males from each population used the same three, highly stereotyped temporal display structures (i.e., display types, labeled A, B, and C) in their display repertoires, and that all three of these types were used across all measured recording environments and social contexts. Furthermore, intra-display structure was not affected by recording environment or social context, but within the relatively small total variance, a significant population effect was found for a majority of intra-display units.

EFFECT OF FLUNIXIN MEGLUMINE ON LIPOPOLYSACCHARIDE-INDUCED PREGNANCY LOSS IN CD-1 MICE. R. J. Matthews and A. E. Conway, Dept. of Biol., Randolph-Macon Col., Ashland, Va., 23005, and C. M. Conway, Dept. of Biol., Va. Commonwealth Univ., Richmond, Va. 23284-2012. Pregnancy loss induced by non-exotoxin producing Gram-negative bacterial infections is mediated by lipopolysaccharides (LPS) released from bacteria. LPS effects may be mediated in part by induced inflammatory prostaglandin secretion, but other prostaglandins may inhibit inflammatory mechanisms. The effect of the anti-inflammatory drug flunixin meglumine (FM) on frequency of LPS-induced pregnancy loss was studied in CD-1 mice. Five  $\mu\text{g}$  of LPS in 50  $\mu\text{l}$  of phosphate-buffered saline (PBS) was injected intravenously on day 9 of gestation (plug = day 1). Fifty  $\mu\text{l}$ /day of 1.2  $\mu\text{g}/\text{ml}$  flunixin in PBS was injected subcutaneously on days 8-11 of gestation. Control mice received PBS in place of LPS and/or FM. Mice were sacrificed on day 12 of gestation and evaluated for frequency of pregnancy loss. Treatment with FM significantly increased pregnancy loss and slightly increased body weight loss in response to LPS but had no effect on either parameter in the absence of LPS. Since FM is a strong inhibitor of the initial steps in prostaglandin synthesis, these results suggest that the prostaglandins produced in the pregnant CD-1 uterus after LPS exposure have a net anti-inflammatory effect.

ENVIRONMENTAL FACTORS AFFECTING ZOOPLANKTON COMMUNITIES. George B. Mateja, Dept. of Biological Sciences, Old Dominion University, Norfolk, Va. 23529-0266, & K. E. Carpenter, Dept. of Biological Sciences, Old Dominion University, Norfolk, Va. 23529-0266. The Biology Department of Old Dominion University has been an active participant in the monitoring of the Chesapeake Bay mesozooplankton communities since the inception of the Chesapeake Bay monitoring Program in 1985. Recent analyses of the Chesapeake Bay mesozooplankton community indicates that the mesozooplankton community has been in decline since the inception of the Chesapeake Bay monitoring program and that the abundance have declined as much as 75 percent. This project investigates the environmental factors affecting the mesozooplankton communities in the lower Chesapeake Bay. Relationships between water quality, phytoplankton and zooplankton groups were explored using a linear regression model of biotic and abiotic components. Margalef's index of diversity, zooplankton abundance and biomass were the descriptors of mesozooplankton community health. The overall bay-wide regression analyses indicate that all three zooplankton community parameters display a strong negative relationship with total nitrogen (TN) and bottom dissolved oxygen (BDO). In addition, the diversity index explains a greater amount of the model variation than do the abundance and biomass community indices. The individual station regression analyses show a greater diversity of responses and diversity explains a greater amount of the model variation within the station-based analyses. A negative relationship with TN and BDO also appear in the Mainstem stations, however, the tributaries do not reflect a similar set of responses.

HENRY EDWARD CRAMPTON AND THE MENDELIAN REVOLUTION. James Murray, Dept. of Biol., Univ. of Va., Charlottesville, VA 22901. H. E. Crampton was something of a polymath in biology. He discovered the embryological basis of sinistrality in the development of Physella heterostropha and carried out early parabiologic experiments with the large Saturniid moths. He demonstrated stabilizing selection on the body measurements of Philosamia cynthia, and he participated in collecting along a biological transect from Georgetown, Guyana to the slopes of Mount Roraima. It is, however, on his "Studies on the Variation, Distribution, and Evolution of the Genus Partula" that his reputation rests. He concluded from this work (1) that the variation in the color, banding, and chirality of the shells was Mendelian in nature, (2) that these characters are unaffected by selection, and (3) that active evolution was demonstrable in the short time between his successive samples. Although the second and third of these conclusions appear to be badly flawed, the Partula studies nevertheless exerted an important influence on the Modern Synthesis of Evolutionary Biology via the seminal works of Th. Dobzhansky, Julian Huxley, and Ernst Mayr.

ION MOBILITY SPECTROMETRY WITH SAMPLES OF BIOLOGICAL ORIGIN. Henri K. Parson, Edward J. Poziomek, Andrea A. Chambliss, and Barbara Y. Hargrave, Dept. of Chemistry and Biochemistry and Dept. of Biological Sciences, Old Dominion Univ., Norfolk, VA 23529. Female non-pregnant New Zealand white rabbits were anesthetized with Ketaset and Rompun. The tissues from various organs of the animals, including the brain, kidney, liver, atria, ovary, ventricle, adrenal gland, renal artery, and lung were extracted and dried. Brain tissue samples were analyzed using ion mobility spectrometry (IMS) in order to optimize the analysis procedures. The sampling time and desorber temperature were varied in order to determine the best analysis conditions for the detection and/or identification of drugs and their metabolites in animal tissue. The results of these experiments provide invaluable information for further studies using IMS to evaluate biological samples.



EFFECT OF AMINO GUANIDINE AND OF PENTOXIFYLLINE ON LIPOPOLYSACCHARIDE-INDUCED PREGNANCY LOSS IN CD-1 MICE. A. B. Rhodes and A. F. Conway, Dept. of Biol., Randolph-Macon Col., Ashland, Va., 23005, and C. M. Conway, Dept. of Biol., Va. Commonwealth Univ., Richmond, Va. 23284-2012. Pregnant CD-1 mice were injected intravenously with 5 or 10  $\mu\text{g}$  of E. coli lipopolysaccharide (LPS) on day 9 of gestation (plug = day 1) to induce pregnancy loss. Control animals received PBS injections. Nitric oxide synthetase was inhibited with 0.6% aminoguanidine (AG) in drinking water on days 6-12 of gestation. Controls received plain water. Effects of tumor necrosis factor alpha (TNF alpha) were inhibited by intraperitoneal injections of 1.15 mg of pentoxifylline (PXF) in 50  $\mu\text{l}$  of PBS on days 6-11 of gestation. Controls received PBS. Pregnancy loss was evaluated by sacrifice on day 12 of gestation. Macrophage accumulation was monitored by sacrificing females 6 hours after LPS treatment and immunostaining frozen cross sections of implantation sites for Mac-1 and F4/80 positive cells. Neither AG treatment nor PXF treatment significantly reduced the frequency of pregnancy loss induced by LPS, and AG actually increased the frequency of pregnancy loss relative to LPS alone. Therefore neither nitric oxide production nor the action of TNF alpha on neutrophils appeared to be essential to induction of pregnancy loss by LPS. Neither Mac-1-positive nor F4/80-positive cells were increased around implanted embryos in LPS-treated or AG + LPS-treated females, indicating that the macrophage accumulations at 12 and 24 hours after LPS treatment reported in previous studies were probably responding to tissue damage rather than involved in causing loss of the pregnancy.

GRANULATED METRIAL GLAND CELLS IN PREGNANT CD-1 MICE: A PRELIMINARY COMPARISON OF THE LPS-INDUCED RESORBING UTERUS AND THE NORMAL UTERUS. Juanita L. Smith<sup>1</sup>, Arthur F. Conway<sup>2</sup>, and Carolyn M. Conway<sup>1</sup>, <sup>1</sup>Dept. of Biology, Va. Commonwealth Univ., Richmond, VA 23284-2012 and <sup>2</sup>Dept. of Biology, Randolph-Macon College, Ashland, Va 23005. In rodents, granulated metrial gland (GMG) cells containing distinct glycoprotein granules accumulate in the decidua and adjacent myometrium following implantation. Pregnant CD-1 mice were injected either with 10  $\mu\text{g}$  of lipopolysaccharide (LPS) in 0.05 ml of phosphate buffered saline (PBS) or with PBS at 8.5 days of gestation. The injected mice, along with uninjected control mice of equivalent gestational age, were sacrificed at either 6 or 24 hours post-injection. The reproductive tracts were removed and fixed in 4% paraformaldehyde in phosphate buffer. Randomly selected implantation sites were dehydrated and embedded in glycolmethacrylate. Sections (3 - 5  $\mu\text{m}$ ) were stained with azure A-eosin B for general morphology or with periodic acid Schiff (PAS) to facilitate identification of GMG cells. Uninjected control specimens contained large intact GMG cells with distinct PAS+ granules. Decreased numbers of GMG cells, restricted to the periphery of the implantation site, were observed in the 24 hour LPS-injected specimens. In contrast, the implantation sites of the 6 hour LPS-injected specimens were largely intact and contained numerous normal-appearing GMG cells in the decidua and smaller GMG cells near the myometrium. These observations suggest that GMG cells are not among the early events involved in LPS-induced pregnancy loss.

EFFECT OF DIETARY PROTEIN CONTENT ON BODY WEIGHT, ORGAN WEIGHTS, AND URINE VOLUME IN CD-1 MICE. C. M. Thompson and A. F. Conway, Dept. of Biol., Randolph-Macon Col., Ashland, Va. 23005-5505. The effects of reduced (10% crude protein), normal (25% crude protein), and increased (40% crude protein) dietary protein levels on three month old CD-1 female mice were evaluated over 33-35 day treatment periods. Body weights remained constant or increased slightly on the reduced and normal protein diets, but showed a transient decrease during the first several days on the increased protein diet before remaining constant or increasing slightly. The weight patterns were not statistically significantly different. Spleen and liver weights were not significantly altered by dietary protein levels, although liver weights in mice on either reduced or increased protein diets were slightly lower than in mice on normal protein diets. Kidney weight and urine volume were significantly greater in mice fed increased protein diets versus mice fed reduced protein diets, with mice fed normal protein diets having intermediate values. These results indicate that elevated protein diets result in increased urine volume and kidney hypertrophy, suggesting physiological stress on the kidneys. Reduced protein diets appeared to have opposite and less severe consequences.

ANTI-CARCINOGENIC EFFECTS OF LYCOPENE ON RB1 CELLS. Michelle Turner and Rosemary Barra, Dept. of Biological Sciences, Mary Washington College, Fredericksburg, VA. Lycopene is a carotenoid found in edible plants like tomato, watermelon, and pink grapefruit. Recent studies have shown that it is effective in preventing certain types of cancer because it is a strong antioxidant. In this study, the effect of lycopene on human retinoblastoma cell viability in the presence of the DNA damaging agent methylmethanesulfonate (MMS) was observed. Preliminary experiments were conducted to determine concentrations of both MMS and lycopene that would not be too toxic to the retinoblastoma cells. Based on the results from the preliminary experiments, the cells were then exposed to 0.05 mg/ml lycopene and 10 mM MMS for a period of 24 hours. Results showed that 10 mM MMS caused less than 10% cell death in the presence of lycopene as opposed to over 20% cell death in the absence of lycopene.

## Biomedical and General Engineering

INTELLIGENT BUILDING ASSEMBLIES: LEVELS OF ANALYSES AND USEFUL TOOLS. Khaled Nassar, Dept. of Building Construction, Virginia Tech, Blacksburg, Va., 24061, The treatment of building components as intelligent objects in construction assemblies will significantly increase the efficiency of design in terms of economy and performance. This is because issues related to the specific design can be addressed in an organized way. Issues like life cycle costs and value engineering can be taken into consideration at the design level, instead of the later stages. In order to add intelligence to building assemblies we must be able to add performance and evaluation methods to each assembly entity. However the performance of an assembly can be modeled and measured at various levels of detail and abstraction. Any research effort which addresses this issue must have a methodology for dealing with this problem of abstraction. A model for the systematic generation of building assembly designs is developed. A computer program which implements the concept of the research is supported. Assemblies are studied and then put in a suitable representation. A symbolic reasoning process is developed. This process entails extracting the required knowledge from schematic design and then forms the basis for possible rules on the placement of building components. This is to support the process of adapting the retrieved cases to the specific design situation.

## Botany

ENCAPSULATION OF *SAINTPAULIA IONANTHA* SHOOT PRIMORDIA. D.T. Bolick and M. H. Renfroe. Dept. of Biology, James Madison University, Harrisonburg, VA 22807. Mass propagation and distribution of commercially-important plants which do not typically set seeds may be accomplished by encapsulation of shoot tips. Leaf explants of African violet were cultured on a medium which promoted shoot regeneration. Shoot primordia were excised from the axenic cultures and encapsulated in a hydrogel matrix consisting of 2% sodium alginate complexed with 100 mM  $\text{CaNO}_3$ . Encapsulated shoot primordia were planted into test tubes containing sterile vermiculite wetted with a shoot growth medium. Emergence and growth of shoots was 100%. The plants rooted spontaneously and were transferred to potting soil and acclimatized to ambient humidity. Subsequently, planting of encapsulated primordia was attempted in non-sterile conditions. The treatments compared with the control group were (1) inclusion of the fungicide carbendazim into the alginate and (2) a treatment of alginate dissolved into one-half strength MS macronutrients instead of water. As a control, shoots were encapsulated in a matrix consisting of 2% sodium alginate complexed with 100 mM  $\text{CaNO}_3$ . Encapsulated shoots were planted into non-sterilized greenhouse flats filled with medium grade vermiculite wet only with water. Shoots emerged and developed into established plants in all groups. Encapsulation of African violet shoot primordia in alginate provides

A SURVEY OF PLANT COMMUNITIES AT HAWKRIDGE FARMS, RAPPAHANNOCK AND CULPEPER COUNTIES, VIRGINIA. Beth A. Clark, Amy G. Davis\*, Deanna R. Estes\*, Bryan T. Newman\*, Alex R. Personius, W. Corbin Steele\*, and Woodward S. Bousquet, Biol. and Env. Studies Programs, Shenandoah University, Winchester, Va. 22601. Research took place during 1997 at Hawkridge Farms, a 33-acre tract of land which straddles the border of Rappahannock and Culpeper Counties, Virginia. Communities were examined using representative sample plots, called 'releve's. For each 'releve', plant species were identified, physical characteristics were measured, and the composition of the vegetation layers was described on a percent-cover basis. The plant communities were characterized and compared through measures of species diversity. Braun-Blanquet tables were prepared for each community to calculate and display species dominance. A preliminary list of vascular plant species was compiled, consisting of 237 species in 67 families. This list included 12 new species records for Rappahannock County, and 21 for Culpeper County.

A CAROLINA HEMLOCK (*Tsuga caroliniana* ENGELM.) COMMUNITY IN THE BLUE RIDGE PROVINCE OF VIRGINIA. Robert B. Cox, Robert J. Goldstein and Associates, Inc., Raleigh, NC 27616, James S. Rentch, School of Engineering and Information Technology, Marshall Univ. Graduate College, South Charleston, WV 25202, Harold S. Adams, Div. of Arts and Sciences, Dabney S. Lancaster Community College, Clifton Forge, Va. 24422, & Steven L. Stephenson, Dept. of Biology, Fairmont State College, Fairmont, WV 26554. A Carolina hemlock (*Tsuga caroliniana*) community in Virginia was sampled in July, 1997. Located at Bottom Creek Gorge near Roanoke, the site was first examined in 1935 and is protected by the Virginia Nature Conservancy. Using standard 0.1 ha sampling methods, vascular plants in the tree, small tree, sapling, shrub, seedling, and herbaceous strata were sampled, and increment cores were taken to establish an age diameter relationship. A visual assessment of crown vigor was also made. The importance value (IV) of Carolina hemlock was 49.2, 89.7, and 38.5 in the tree, small tree, and sapling strata, respectively. This community has an age-diameter regression of  $(y=32.2 + 2.12x)$ , and appears to be a stable, uneven aged forest with a peak in the 60-70 year old age class. Three stems are older than 150 years of age. No dead hemlocks were observed and 71.8% of the stems had less than 50% damage to the tree crowns. Possibly, the dominance of hemlock here may be due to the removal of American chestnut in the 1930's. Finally, the success of Carolina hemlock at this site may be attributed to its stress-tolerant life strategy.

VIABLE SEEDS OF *VERBASCUM THAPSUS* FROM AN ARCHEOLOGICAL SITE. R. Dean Decker, Dept. of Biology, University of Richmond, VA 23173. Botany and particularly Plant Physiology textbooks indicate that seeds of most species have a viable period of under five years. As the number of years of seed longevity increases, the number of species decreases. Longevity of 100 years or more is very rare, particularly when the seeds occur in the species' normal habitat. At an archeological site located on the Flowerdew Hundred plantation near Hopewell, VA, *Verbascum thapsus* plants were found flourishing in a newly exposed four inch layer of soil approximately two feet below the surface. Archeological data indicated that this soil layer has been covered for 200-220 years. These seeds of *V. thapsus*, which require light to germinate, had remained viable in a natural habitat for more than 200 years.

ANATOMY OF SECONDARY XYLEM IN THE *ACALYPHA VIRGINICA* COMPLEX. W. John Hayden & Sheila M. Hayden, Dept. of Biol., Univ. of Richmond, Richmond, VA 23173. Stems of *Acalypha deamii*, *A. gracilens*, *A. rhomboidea* and *A. virginica* were studied for secondary xylem structure. The annual stems, up to 5 mm in diameter, were sectioned unembedded on a sliding microtome for light microscopic examination of sections stained in safranin and hematoxylin; woods were also macerated in Jeffrey's fluid and stained in safranin. Vessels are distributed evenly across the wood in a mixture of solitary pores, radial multiples, and clusters. In *A. gracilens* perforations are strictly simple; otherwise, vessel elements bear mixtures of simple and anomalous perforations. Perforation anomalies include: irregular outlines; presence of one or more bars, or partial bars, or looped bars of secondary wall material; and retention of the primary wall, sometimes with bars, loops, or disks of secondary wall seemingly suspended in the perforation aperture. Intervascular pits are circular and alternate. Libriform fibers are thin-walled and not septate. Axial parenchyma is restricted to rare paratracheal cells. Rays are uniseriate and biseriata, or strictly uniseriate in *A. gracilens*. Rays are homocellular erect. Crystals are absent. Secondary xylem of woodier, tropical species of *Acalypha* differs by virtue of longer vessel elements and fibers, absence of anomalous perforations, septa in the fibers, and wider, more heterocellular rays that also bear crystals.

SPRING WILDFLOWERS OF THE MID-ATLANTIC REGION: THE AGONY AND THE ECSTASY OF VIDEO PRODUCTION. Marion B. Lobstein, Associate Professor of Biology, NVCC-Manassas Campus, NVCC-Manassas Campus, 6901 Sudley Rd., Manassas, VA 20109 and Adjunct Professor, Blandy Experimental Farm, Boyce VA 22620. This 44-minute video on spring wildflowers of this mid-Atlantic region had its origin in a summer 1996 Field Botany course Lobstein taught at Blandy Experimental Farm, UVA's field station near Winchester. Two Loudoun County high school biology teachers, John DeMary and Suzanne Lohr, participated in this class and as part of their class project, produced the first version of this video. Lobstein and these two teachers decided to upgrade and expand the photography and text of the video and to have it professionally produced. The three subsequently formed a company Botanical Views, LLC. These efforts culminated in the production of the video in late 1997 by CDR Communications in Springfield, VA. Almost 100 species of spring wildflowers were covered in this video with conservation, life cycle, historical medicinal and edible use, habitat, and hazardous plants information. Initial marketing of this video during the first half of 1998 has been successful. The steps necessary to produce and market this educational video are covered in this presentation. The positive experiences as well as the challenges of these efforts are also covered in this presentation to provide other educators considering similar projects a realistic view of what to expect with such a project.

FURTHER STUDIES OF XYLEM DEVELOPMENT IN RHIZOMES OF *SAURURUS CERNUUS*. Leonard S. Machut & W. John Hayden, Dept. of Biol., Univ. of Richmond, Richmond, VA 23173. *Saururus cernuus*, known as Lizard's Tail, is a rhizomatous herb of wetland habitats found throughout eastern North America. We sampled rhizome structure at regular intervals from young, distal growing tips to the oldest, proximal structures obtainable. Sections were made unembedded on a sliding microtome and stained with a combination of safranin and hematoxylin. As in previous studies of samples from Virginia, we found relatively constant amounts of primary xylem and only primary xylem through most regions of the rhizome. Constancy of xylem development was reflected in both the number of mature elements per bundle and the radial dimension of xylem tissue. A small amount of secondary xylem was observed in a robust specimen from Louisiana and in a robust portion of a Virginia specimen otherwise characterized by primary xylem only. No specimen showed a steady, regular increase in secondary xylem with age and, where present, secondary xylem was restricted to a few tracheary elements formed within the vascular bundle.

SPECIES WITHIN THE *PFIESTERIA PISCICIDA* COMPLEX IN VIRGINIA WATERS DURING 1997. H. Marshall, D. Seaborn, and J. Wolny, Dept. Biological Sci., Old Dominion Univ., Norfolk, VA 23529-0266. Water samples from Virginia rivers and the Chesapeake Bay were examined for species in the *Pfiesteria* complex between June and September 1997. 144 water samples from 43 sites were examined using light microscopy to identify cells suspected to be in this group. These sites were where high numbers of fish with lesions were found. Presumptive cell counts were based on their size, morphology, staining, and similarity to gymnodinoid type cells similar to *Pfiesteria*. Suspect samples, containing 150-250 cells/ml, from each of these 4 sites were verified as members of this complex by Dr. J. Burkholder using SEM protocols. These sites were located in the Rappahannock (2), Great Wicomico, and Pokomoke (Virginia section) Rivers. Toxic bioassay tests using cells from the 4 sites were conducted by Dr. Burkholder. There were no positive toxicity results from these samples. Supported by the Virginia Department of Environmental Quality.

#### DINOFLAGELLATE CYSTS IN CHESAPEAKE BAY AND THREE VIRGINIA RIVERS.

D.W. Seaborn and H.G. Marshall. Dept of Biological Sciences, Old Dominion University, Norfolk, Virginia. 23529-0266. Dinoflagellate cysts were identified from surface sediment core samples collected within the lower Chesapeake Bay, and the James, York, and Rappahannock Rivers. The greatest diversity of cysts was near the Bay entrance while abundance was highest downstream in the rivers. 19 dinoflagellate taxa were identified, three of which have been associated with toxin production. These are *Lingulodinium macherophorum* (*Gonyaulax polyedra*), *Hemicystis zoharyi* (*Pyrodinium bahamense*), and *Cochlodinium heterlobatum* (*C. polykrikoides*). Other species were *Gyrodinium fusiforme*, *Heterocapsa triquetra*, *Nematospheopsis balcombiana* (*Gonyaulax spinifera*), *Operculodinium centrocarpum* (*Gonyaulax grindleyi*), *Polykrikos kofoidii*, *Protoberidinium conicum*, *P. depressum*, *P. leonis*, *P. pentagonum*, *Scrippsiella trochoidea*, *Spiniferites bulloides* (*G. scrippsae*), *S. elongatus*, *S. mirables*, *Tectatodinium pellitum*, and *Tuberculodinium vancampoeae*. Supported by Virginia Department of Environmental Quality.

THE CULTURING AND LIFE HISTORY OF *CRYPTOPERIDINIOPSIS* SP.: A MEMBER OF THE *PFIESTERIA* COMPLEX. D.W. Seaborn and H. G. Marshall. Dept. of Biological Sciences, Old Dominion University, Norfolk, Virginia. 23529-0266. Three known members of the "*Pfiesteria* complex" have been cultured in a non-toxic state, supported by an algal food source, the cryptophyte *Rhodomonas*. These included *Pfiesteria piscicida*, *Cryptoperidiniopsis* sp. (gen. nov. Steidinger), and a scrippsielloid-like dinoflagellate known as "Shepherd's crook" (K. Steidinger). They typically feed myzotrophically using a peduncle but can feed phagotrophically in amoeboid stages. Using a similar protocol, sediment samples from several Virginia sites are being used to determine the spatial distribution of these and other *Pfiesteria*-like dinoflagellates in Virginia's waters. Several benthic, heterotrophic dinoflagellates have been observed which are similar in size and shape to *Pfiesteria piscicida* and are now under further investigation using scanning electron microscopy. Supported by Virginia Department of Environmental Quality.

SUMMER PHYTOPLANKTON POPULATIONS IN A BRACKISH WATER LAKE IN PORTSMOUTH, VIRGINIA. J. L. Wolny, Department of Biological Sciences, Old Dominion University, Norfolk, Virginia, 23529-0266. A 12 month study of phytoplankton populations in a brackish-water lake was conducted from May 1997 to May 1998. The lake is approximately 30 acres in size, has a maximum depth of 17m, and lies within Hoffer Creek Wildlife Refuge, Portsmouth, Va. Monthly surveys of 2 stations at 2 depths (surface and 3m) included collections of replicate phytoplankton and picoplankton samples used in analysis of community abundance and composition as well as the measurement of several physical and chemical parameters. Reported here are preliminary results for samples taken from June to August, during which time mean salinity levels in the water column were 5.5ppt. Summer flora was represented by both characteristic freshwater and estuarine species. Mean summer concentration for the Chlorophytes was  $2.3 \times 10^6$  cells/L. Filamentous Cyanobacteria concentrations averaged  $1.0 \times 10^6$  trichomes/L, whereas the dominant colonial form, *Microcystis inserta*, averaged  $1.3 \times 10^8$  cells/L concentrations. Epifluorescent work showed the picoplankton abundance increased from June to August, with an average concentration of  $1.0 \times 10^8$  cell/L.

## Chemistry

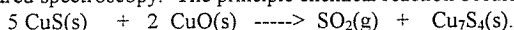
COMPLEXES OF THE N-(3,5-DIMETHYLPHENYL)PHTHALAMATE LIGAND WITH Co(II), Ni(II), Cu(II), AND Zn(II). Scott D. Allen, Dept. of Chem., Va. Commonwealth Univ., Richmond, VA 23284. This work is part of a broader project that investigates the coordinating ability of the amic acid sites of polyimides through a study of the metal complexes of representative monomeric amic acid models. N-(3,5-dimethylphenyl)-phthalamic acid (HXYNPPA), synthesized from 3,5-xylidine and phthalic anhydride, was reacted with the acetates of complexes of the general formula  $M(XYNPPA)_2 \cdot n(H_2O)$ . The composition of the complexes was established by elemental analysis and thermogravimetric measurements; their structures were studied by a combination of spectral measurements: infrared and visible-ultraviolet absorption spectra for the Co(II), Ni(II), and Cu(II) complexes, infrared and proton nuclear magnetic resonance for the Zn(II) complex. (Group project of the CHE 406L Class of 1998; Instructors: D.L. Smailes and L.M. Vallarino)

SURFACE ADSORPTION AND RETENTION OF TNT VAPORS. Saeed H. Almeer and Edward J. Poziomek, Department of Chemistry and Biochemistry, Old Dominion University, Norfolk, VA 23529-0126. The primary objective of this research was to develop an inexpensive and reliable method to generate vapor pulses of explosives using 2,4,6-trinitrotoluene (TNT) for proof of concept. A secondary objective was to demonstrate the use of the vapor generator in various applications keeping in mind potential field scenarios involving explosives. A vapor generator/collector system was developed which gives reproducible pulses of TNT vapors at nanogram levels. The use of this technology was demonstrated in evaluating different surfaces for vapor adsorption of TNT in conjunction with ion mobility spectrometry as the primary analytical tool. Of the materials examined, Teflon was by far the best substrate for adsorption, retention, and subsequent recovery of TNT using ion mobility spectrometry for analysis.

VIBRATIONAL ZERO-POINT ENERGIES AND THE INTERNAL ROTATION POTENTIAL FOR AN ASYMMETRIC METHYL ROTOR. Stephen L. Davis, Dept. of Chemistry, George Mason Univ., Fairfax, Va. 22030. Optimized geometries and quadratic force constants were calculated for both staggered and eclipsed conformations of CH<sub>3</sub>OH. Both the Hartree-Fock and the B3-LYP density functional methods were used, each with two different basis sets - 6-31G(d) and 6-311+G(d,p). The mass-weighted force constant matrix for each isotopomer of CH<sub>3</sub>OH was diagonalized to obtain harmonic vibrational frequencies for each of the normal modes. Molecules studied included both staggered and eclipsed forms of the symmetrical isotopomers CH<sub>3</sub>OH, CH<sub>3</sub>OD, CD<sub>3</sub>OH, CD<sub>3</sub>OD and both *gauche* and *trans* variants of staggered and eclipsed forms of the asymmetrical isotopomers CH<sub>2</sub>DOH, CH<sub>2</sub>DOD, CHD<sub>2</sub>OH, CH<sub>2</sub>DOD. Zero point energies for each of these conformers and isotopomers were obtained from the sum of the harmonic frequencies of the 11 non-torsional modes. The zero point energies were then used to obtain the Fourier coefficients for the internal rotation dependence of the potential energy surface, V<sub>1</sub>, V<sub>2</sub>, and V<sub>3</sub>, for each molecule. These ab initio potential parameters were compared with experimental values obtained from molecular spectroscopy. The agreement is good, especially for V<sub>1</sub>, but only qualitative for V<sub>2</sub>. The calculated zero point vibrational energy contributions to V<sub>3</sub> follow the changes in the experimental internal rotation barriers for the different isotopomers.

A REVISED METHOD OF MEASURING TEMPERATURE PROGRAMMED REACTIONS OFF SURFACES. Jason V. de la Peña, John A. Schreifels Dept. of Chemistry, George Mason Univ., Fairfax, VA 22030-4444. Temperature programmed desorption techniques are commonly used by surface scientists to determine how molecules interact with the surface upon adsorption from the gas phase. A mass spectrometer measures the partial pressure of a particular molecular mass as the sample is heated. Simultaneous monitoring of several masses is presently common. Using these masses one can determine the partial pressure of substances formed from reaction of the original molecule with the surface. A method will be outlined that allows one to acquire spectra for at least a 50 amu mass range during the heating process. Approximately 40,000 points are in the final datafile that is processed using Sigma Plot to obtain a contour plot. This insures that no reaction products are undetected by providing a quick overview of the intensities of all masses during the experiment. After collecting data in this manner as a function of exposure, uptake curves of individual masses can be obtained and are the same as those from the traditional method.

REACTION BETWEEN CUS(S) AND CUO(S) AT TEMPERATURES BELOW 900 K  
Thomas C. DeVore, Department of Chemistry MSC 7701, James Madison University, Harrisonburg VA 22807. The reaction between CuS(s) and CuO(s) at temperatures below 900 K has been investigated using differential scanning calorimetry and evolved gas analysis Fourier transform infrared spectroscopy. The principle chemical reaction occurring in this region is



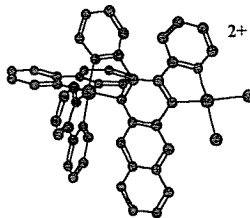
The enthalpy of reaction determined for this reaction is  $12 \pm 3$  kJ/ mol. Kinetic measurements indicate that the reaction follows the Ginstling-Brounstein Diffusion Mechanism and has an activation energy of  $180 \pm 10$  kJ/ mol. The rate limiting step for this reaction is the formation of sulfur vapor from the thermal decomposition of the CuS(s).

PHYTOESTROGENS AS POTENTIAL ANTI-CANCER AGENTS, Mark Elliott, Roy L. Williams and Gary Morris, Old Dominion Univ. Enological Research Facility, Dept. Of Chem./Biochem., Old Dominion Univ. , Norfolk, VA 23529. Scientific information continues to appear that suggests that certain phytoestrogens may be important chemoprotective agents in the diet. The phytoestrogens appear to exhibit a wide variety of possible mechanisms of action with regard to antioxidant activity, antiviral activity and anti-cancer activity. This laboratory has continued to study the effects of certain isoflavonoid phytoestrogens such as genistein and daidzein as well as several stilbene antiestrogenic agents including diethylstilbesterol (DES) , trans-tamoxifen and trans-resveratrol. This paper will describe the results of this study with two human breast cancer cell lines (MCF-7 and MDA-231) as well as the hormone dependent prostate cell line known as LNCaP. The effects of these agents on the growth of these cell lines will be discussed. In addition, the effects of these agents on cell lines will be discussed.





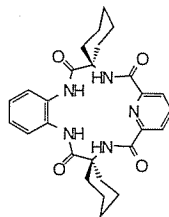
DNA BINDING STUDIES OF PLATINUM-RUTHENIUM AND PLATINUM-OSMIUM MULTIMETALLIC COMPLEXES. Matthew Milkevitch, Brenda W. Shirley\*, and Karen J. Brewer\*, Departments of Chemistry and Biology, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061. In modern scientific research, a serious and ongoing concern is over the development of new agents for cancer chemotherapy. In recent years, this field has expanded tremendously, with some of the most notable achievements being the discovery of the anticancer and DNA binding activity of transition metal complexes. The most notable examples in this area include cisplatin, carboplatin, and numerous ruthenium polypyridyl complexes. Currently, efforts continue in the elucidation of their mode of action, along with the development of suitable analogs. In our research, four novel mixed-metal complexes of the general form  $[(bpy)_2M(BL)PtCl_2]Cl_2$  (where  $M = Ru^{II}$  or  $Os^{II}$ , BL = 2,3 bis-(2-pyridyl)quinoxaline (dpq), and 2,3 bis-(2-pyridyl)benzoquinoxaline (dpb)) have been synthesized and characterized. These systems are DNA binding agents capable of multiple modes of binding. Information on the nature of DNA binding as studied by gel electrophoresis is the subject of this presentation. This work is supported by NSF CHE- 9632713 and the Jeffress Memorial Trust (Grant J-370).



TRACE AMOUNTS OF PENICILLIN IN WINES-FACT OR FICTION?, Gary Morris, Roy L. Williams and James Yuan, Old Dominion Univ. Enological Research Facility, Dept. Of Chem./Biochem., Old Dominion Univ., Norfolk, VA 23529. The presence of traces amounts of various organic substances such as pesticides and ethyl carbamate is of considerable interest to the wine industry. One compound that has not been considered in this regard is penicillin! Since grapes are known to develop levels of natural or native yeast prior to fermentation, the question arises whether or not penicillin could be a trace contaminate in some wines. The presence of trace amounts of this antibiotic in wine would be of major interest to those consumers that might be prone to some level of hypersensitivity to penicillin. This laboratory has carried out a study which shows that penicillin G is relatively unstable in wine due to the inherently low pH of wine. Analytical methods will be described that demonstrate this instability of penicillin and document the first order hydrolysis of penicillin G in wine.

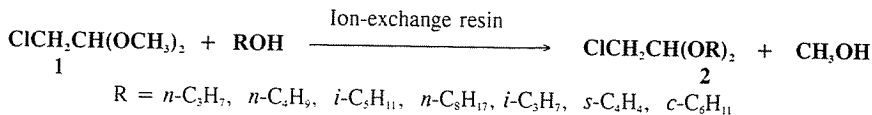
GC AND GC-MS STUDIES OF COCAINE REACTION WITH GLASS. Grazyna E. Orzechowska, Department of Chemistry and Biochemistry, UCLA, Los Angeles, CA 90095-1569, and Edward J. Poziomek, Department of Chemistry and Biochemistry, Old Dominion University, Norfolk, VA 23529-0126. We have been interested in the chemistry of contraband drugs on various surfaces in connection with new concepts in sampling and detection of the drugs. The objective of the present work is to better understand the factors governing the reaction of cocaine freebase and cocaine HCl with surfaces containing silica. The choice of silica was based on our observations that such materials are among the most reactive of those screened with cocaine. The analytical methodology was based on gas chromatography (GC) and gas chromatography - mass spectrometry (GC-MS). Experiments were designed using GC liner tubes packed with different silica materials and mounted in injection ports of the GC and GC-MS systems. Glass wool which was not silanized appeared the most reactive of the silica materials examined. Silanized glass wool gave no reaction under any condition including a temperature of 250 C. The major products were methyl ecgonidine and benzoic acid though methyl ecgonine and benzoylecgonine were also found.

**SYNTHESIS AND CHARACTERIZATION OF PENTADENTATE TETRAAMIDE MACROCYCLE** Leonard Rorrer, Erich S. Uffelman, Trey Lee. Department of Chemistry, Washington and Lee University, Lexington, VA 24450. We have synthesized a pentadentate tetraamide macrocycle for use in coordinating transition metal and especially lanthanide ions. Two different derivatives of the macrocycle have been made, one with a butyl group on the benzene ring and the other without the butyl group. Both of these compounds have been characterized by  $^1\text{H}$  NMR,  $^{13}\text{C}$  NMR, COSY, NOESY, and selective homonuclear decoupling. The butyl derivative has also been characterized by electrospray MS. Significantly, the underivatized macrocycle can be synthesized in good yield from commercially available compounds in a three step process. An amino acid is reacted with  $\text{PCl}_5$  to yield an amino acid chloride which is then reacted with phenylene diamine to give a diamide diamine. The diamide diamine is then reacted with 2,6-pyridinedicarbonyl dichloride to give the macrocycle.



**COMPUTERIZED GENERAL CHEMISTRY QUIZZES.** John A. Schreifels, Dept. of Chemistry, George Mason Univ., Fairfax, VA 22030-4444. The administration of in-class quizzes is a well-established method of insuring that students are working at the proper rate and level. Additionally, it helps diagnose potential problems so that student and teacher can attempt to solve them. To avoid using valuable class time, a Visual Basic program has been written to administer algorithmic quizzes. Quizzes are administered in a small room equipped with 15 computers that form an intranet. The program allows a student to take up to 40 minutes to finish. Multiple tries as well as a hint are provided for a penalty. The highest grade, time spent and date of each attempt are stored on a database. Deadlines are set for each quiz after which a student may not take it. Approximately 250 students from several lecture sections have successfully used the program throughout the semester. Since the tutoring center occupies space in the same room, students can obtain help immediately after a quiz. Performance on quizzes has improved by about 50% compared with in-class quizzes. It has been helpful to students suffering from severe test anxiety.

**TRANSACETALIZATION: A FACILE PATHWAY FOR THE SYNTHESIS OF 2° DIALKYL ACETALS.** Wayne M. Stalick, Department of Chemistry, George Mason University., Fairfax, VA 22030. Chloroacetaldehyde diethyl acetal was shown to be a precursor to the useful intermediate ethoxyacetylene. A later expansion of this reaction showed that other 1-ethoxy-1-alkynes could be easily made using a one-pot synthesis. Further reactions showed that acetals with more complex alcohols also reacted to produce a wide variety of alkoxy alkynes and alkylnols. This latter reaction required the development of a general synthesis for a variety of chloroacetaldehyde dialkyl acetals **2**. The present work describes a versatile, high-yielding synthesis of **2** using an acid resin catalyst for transacetalization of the readily available, inexpensive chloroacetaldehyde dimethyl acetal **1**. An interesting result of using this catalyst is the production of acetals from 2° alcohols as summarized in the following equation:



ELIMINATING INTERFERENCES IN FIELD DETECTION OF CONTRABAND DRUGS. Alyssa L. Tippens, Julia Homstead, & E. Poziomek, Dept. of Chem. & Biochem., Old Dominion Univ., Norfolk, VA 23529. Ion mobility spectrometry (IMS) is one of the field analytical techniques used in the detection of contraband drugs such as cocaine freebase and cocaine hydrochloride. The principle of IMS involves gentle ionization of molecules and the analysis of subsequent ions using gas ionic mobilities. It has been reported that fuel oils may interfere in the IMS detection of cocaine by retarding its' ion signal. This could be due to competition for ionic charge between oil components and cocaine. We have studied the positive ion properties of six marine diesel oils in the presence and absence of cocaine hydrochloride. It is clear the cocaine ion peak is retarded. Also, it was interesting to find the addition of quinoline serves to reduce the background oil signal and in some cases allows the cocaine to be detected.

BACTERIAL DEGRADATION OF HALOACETIC ACIDS IN DRINKING WATER. Roy L. Williams and James Yuan, Dept. of Chem./Biochem., Old Dominion Univ., Norfolk, VA 23529 and Sherry Williams, Newport News Water Works, Newport News, VA. The presence of various disinfection by-products (DBPs) in drinking water has become a major concern to the public and many utilities across the United States. One class of disinfection by-products known as the haloacetic acids or HAAs have been shown to exhibit questionable biological properties that may produce some risk over long periods of consumption. This laboratory has continued to investigate a unique and natural degradation mechanism for the removal of HAAs from drinking water. Active biofilms have been identified at maximum residence locations (MRTLs) in the Newport News distribution system which apparently contain an active bacteria which is capable of degrading many of the known HAAs. The degradation appears to occur via a haloacid dehalogenase mechanism. The preliminary results of this study will be described together with the method for culturing of this bacteria and the analytical methods used to study this degradation of the HAAs.

ANTIOXIDANT POTENTIAL OF KNOWN PHYTOESTROGENS, Roy L. Williams and Tara Rutledge, Old Dominion University Entomological Research Facility, Dept. Of Chem./Biochem., Old Dominion Univ., Norfolk, VA 23529. The role of phytoestrogens in the diet has become a very exciting area of research and has initiated a great deal of consumer interest in the nutraceutical industry. The phytoestrogens have been implicated in the control of a variety of dysfunctions from heart disease to the problems associated with menopause. One of the major modes of action typically associated with these phytoestrogens and other polyphenolic species, is their inherent antioxidant potential. As effective antioxidants these compounds may protect important metabolic pathways or biochemical mechanisms by eliminating reactive oxygen species (ROS) or free radicals. We have recently examined the total antioxidant status of several of the more important phytoestrogens using the new RANDOX® antioxidant kit. Using this unique colorimetric method, we have obtained the total antioxidant status (TAS) values for a variety of phytochemicals and will describe certain structure-activity relationships (SAR) within the family of known isoflavonoids and related compounds.

PHYTOESTROGENS IN GRAPE SEEDS AND SOY BEANS. Roy L. Williams and Steve Scherer, Old Dominion University Enological Research Facility, Dept. Of Chem./Biochem., Old Dominion Univ., Norfolk, VA, 23529. Phytoestrogens are organic compounds found in a variety of plants that exhibit estrogenic or antiestrogenic activity *in vitro* and *in vivo*. This class of phytochemicals has received considerable attention with regard to their potential chemoprotective activity against a variety of dysfunctions and disease states. Soy beans have been shown to have exceptionally high levels of these phytoestrogens, especially the isoflavonoids such as genistein and daidzein. High levels of these compounds in the diet of Asian individuals has been implicated in their low levels of breast and prostate cancer. We have recently shown that grape seeds also contain significant levels of these same phytochemicals and as such may provide for a unique source of these compounds in the diet or in the responsible consumption of wine. The analytical methods for the separation and identification of the more predominant isoflavonoids in soy beans and grape seeds will be described.

STABILITY OF MOLTEN COCAINE FREEBASE. Belinda K. Wilmer and Edward J. Poziomek, Department of Chemistry and Biochemistry, Old Dominion University, Norfolk, VA 23529-0126. The FTIR spectrum of cocaine freebase has been reported. However, mulls and organic solvents can interfere with the IR spectra. This can potentially limit the information obtained from the spectra, especially with regard to impurities and degradation products in the cocaine freebase. In order to circumvent this problem, we tried heating cocaine freebase to its melting point (100 C) between two NaCl plates and allowed them to cool to room temperature. This produced a translucent, supercooled film of cocaine freebase that was stable for several hours before crystallizing. In addition to producing a cleaner, sharper FTIR spectrum, this supercooled film can also serve as a convenient and simple method for studying the stability and interactions of cocaine. For example mixtures of cocaine and silica, a common environmental material, were heated for varying time periods, cooled and analyzed by FTIR. This was done in order to see if silica could catalyze the decomposition of the cocaine. Subsequent GC analysis aided in determining the products and possible mechanisms of these reactions.

SURFACE ANALYTICAL TECHNIQUES APPLIED TO ADHESIVES AND SEALANTS. James P. Wightman, Dept. of Chem., Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. One of the recurrent questions in the field of adhesives and sealants concerns surface analysis. The integrity of an adhesive or sealant bonds often depends on the chemical composition of the substrate surface. There are over 100 experimental techniques which could qualify under the umbrella of 'surface analysis'. One of the premier surface analytical tools available today is XPS or x-ray photoelectron spectroscopy. Advantages of the XPS technique include identification of elements in the top 5 nm of the surface of a solid and establishment of the bonding state and atomic concentration of those elements. The XPS technique is sample forgiving requiring minimal sample preparation. Such an analysis is particularly germane in the technologically important area of adhesion since it is the very outermost atomic/molecular layers of a solid which come into molecular contact with an applied adhesive or sealant. Several sets of XPS analyses will be discussed based on samples submitted by industrial colleagues from the adhesive and sealant industry.

SYNTHESIS AND DIMERIZATION OF ALKYL INDOLES. James H. Wynne and Wayne M. Stalick, Department of Chemistry, George Mason University, Fairfax, VA 22030. In efforts to reproduce various sediment formations found in Jet Fuel, the synthesis of 3-alkyl indole dimers was deemed necessary. Hypervalent iodo-species were investigated followed by treatment of various alkyl nucleophiles afforded the desired product in minimal yields. N-Protecting groups were then explored in attempt to allow addition in the desired 3-position. After protection with the p-toluene sulfonyl group and bromination at the 3-position, treatment with t-BuLi followed. Deprotonation was observed in the  $\alpha$  position, rather than the desired lithium halogen exchange. This observation can easily be explained through both coordination effects of the sulfonyl group as well as inductive effects of the nitrogen. When the bulky dimethyl-t-butyl silane protecting group was employed, followed by bromination in the 3-position, the desired exchange was accomplished. The resulting N-protected-3-lithioindoles serve as useful intermediates in the synthesis of the desired 3-alkylindoles as well as other useful synthons. Tetrabutylammonium fluoride facilitated the removal of the silyl-protecting group.

## Computer Science

ENERGY TRANSFER OF SUPRATHERMAL ALPHA PARTICLES IN A RIPPLED FIELD OF A TOKAMAK. Melissa Davis and Maria Lam, Center for Fusion Research and Training and Department of Computer Science, Hampton University, Hampton, VA 23668. We simulate motions of suprathermal alpha particles in the rippled field of a tokamak. A model by Punjabi and Boozer<sup>1,2</sup> is used for this study. A set of coupled nonlinear ordinary differential equations in Boozer coordinates are used to describe the motion. During their journey around a tokamak, alpha particles continuously collide with electrons, deuterium, tritium, and impurity particles of the plasma. In the process, they lose or occasionally gain energy from these particles. We present our preliminary result of this study on energy transfer of suprathermal alpha particles in a rippled field in a tokamak. This work is supported by the US Department of Energy.

A MODEL FOR ASYNCHRONOUS LEARNING USING THE INTERNET. Peter H. Hua, Dept. of Computer Science, Mary Washington Col., Fredericksburg, Va. 22401. The asynchronous learning paradigm is different from the current synchronous learning paradigm in that both students and faculty are not confined to a location or time and multidirectional flow of information is possible. Asynchronous courses of today include and involve many "standard" technologies such as web pages, animation, full-motion video, on-line forums and real-time two way presentations. In addition, these courses can cater to a more diverse demographic community and slow the rising cost of education. According to recent reports, they also provide better access to faculty and save students time since the students are able to work at their pace and at anytime. However, faculty buy-in has been slow at large educational institutions because the infrastructure on which the asynchronous courses must be built is weak. Faculty also report that the time it takes to convert a currently synchronous course to an asynchronous course is slow while the benefits from current asynchronous courses are mediocre for the additional work demanded from faculty. To aid faculty many software packages (such as TopClass, WebCt, and WCB) have been developed to create and manage asynchronous courses using technologies such as web browsers, Java, and cookies.

A TOP DOWN APPROACH TO COORDINATING THE UNDERGRADUATE COMPUTER SCIENCE CORE. Larry Morell and Robert Willis Jr., Department of Computer Science, Hampton University, Hampton, VA 23668. The Department of Computer Science has adopted the philosophy that design should be taught before efficiency. This has impacted the order in which we present material, the integration of material across courses, and the emphasis that we place on certain topics. In the first year students learn and use five basic abstract data types (ADT's: lists, stacks, trees, queues, and sets) in lieu of low-level language primitives for structuring data. Algorithm design using the abstractions is emphasized. Implementation for the abstractions occurs during the second year in a Data Structures sequence. Arrays records and pointers are covered in conjunction with time and space analysis of competing representations. Paralleling this is a one-year sequence in Computer Architecture and Organization where the underlying hardware mechanisms for interpreting programs and data are revealed. An effective mix of languages have been selected appropriate to the material. Ada is used for the abstractions and to support good programming style. C and assembly language are used to illustrate various addressing techniques, bit manipulation, subroutine linkage, and the like. The language of mathematics supports the formal specification of the abstractions and reinforces a language-independent view of data types. Early indications are that the curriculum redesign has positively impacted enrollment, retention and student satisfaction.

DEVELOPING GRAMMARS FOR CONTEXT FREE LANGUAGES: AN EXPERIMENT IN GENETIC PROGRAMMING. Frederick J. Wiendelmayer and Rita M. D'Arcangelis, Dept. of Computer Science, Mary Washington College, Fredericksburg, VA 22401. The object of this investigation was to create a programming system capable of using genetic programming to generate Context-Free Grammars (CFGs) for infinite Context-Free languages, given representative samples of strings in the languages. The system first produces a randomly generated base population of simple Context-Free Grammars. These grammars then become YACC production sets and are used by YACC to evaluate the sample strings in a particular Context-Free language. Based on their success in accepting the samples, some grammars survive and evolve according to a genetic algorithm, with the ultimate goal being to produce an acceptable CFG for the samples. Issues of representation, programming environment selection, number and composition of the samples, as well as techniques for employing mutation, crossover, and fitness are discussed.

## Education

IMPROVING PUBLIC EDUCATION IN GENETICS: A NEW EXHIBITION AT THE SCIENCE MUSEUM OF VIRGINIA. Emily L. Burkett, Dept. of Human Genetics, Med. Col. of Va. of Va. Commonwealth Univ., Richmond, Va. 23298, Eugene G. Maurakis, Science Museum of Va., Richmond, Va. 23220, & Joann N. Bodurtha\*, Dept. of Human Genetics, Med. Col. of Va. of Va. Commonwealth Univ., Richmond, Va. 23298. A basic understanding of genetics concepts is quickly turning from an asset to a necessity for American citizens, especially with the progression of the Human Genome Project. Although current literature suggests a high degree of public interest in genetics, the actual level of public knowledge has been demonstrated to be minimal. It has been suggested that this deficit be addressed through opportunities for public education in genetics, including museum exhibitions. Museum exhibitions are effective teaching tools because they address diverse audiences, incorporate various learning styles, confront misconceptions, hold visitors' interest, and promote continued education outside the museum. A survey of 203 visitors was conducted at the Science Museum of Virginia (SMV) to assess museum visitors' interest in and knowledge of genetics. 94% of visitors appeared to have a basic understanding of genes and most participants acknowledged that genetics somehow impacts their daily life. Although 42% of visitors claimed they were aware of genetic research, only 16% could name a specific aspect of research and only 4% could describe the Human Genome Project. Visitors indicated they are highly interested in learning more about genetics. A genetics exhibition has been designed at SMV to increase local opportunities for public genetics education and to assist SMV in continuing its mission of promoting public education in the sciences. The exhibition uses the Human Genome Project as a model for teaching concepts of DNA and chromosome structure, general genetics, human genetic variation, genetic conditions, human origins, ethical issues, and careers in genetics. The exhibition is scheduled to open in the spring of 2000.

TEACHER CURRICULUM GUIDES IN NUTRITION, FOOD SAFETY, AND BIODIVERSITY. Eugene G. Maurakis, Science Museum of Virginia, Richmond, VA 23220 and Univ. of Richmond, VA 23173, Marilyn Weyer-Elder, FoodSafety Solutions, Richmond, VA 23233, Jennifer Johnson, Univ. of Richmond, VA 23173, and Lara Call, Univ. of Virginia, Charlottesville, VA. 22903. The Science Museum of Virginia (SMV) has produced illustrated Teacher Curriculum Guides in Nutrition, Food Safety, and Biodiversity that are geared to Virginia Standards of Learning (SOL) for K-12 teachers and students. Intent of each guide is to provide K-12 teachers with interactive hands-on activities to complement formal classroom instruction. Each guide contains table of contents, introduction and notice to teachers on use of guides, specific SOLs covered in each activity, background topical information, activity description (objectives, process skills, key words, materials required, procedures, results, and discussion), glossary of terms internet resources, bibliography, and index.

THE CHALLENGE OF VALID STUDENT ASSESSMENT IN SCIENCE. Alvin M. Pettus, School of Education, James Madison Univ., Harrisonburg, VA 22807. As the use of performance assessment methodologies increases in science education for classroom and large-scale assessments, more attention needs to be given to determining the validity of the assessments. Some users consider performance assessments to be valid because they view them as relatively authentic. If the assessment results are used to make certain generalizations about student achievement, however, questions and concerns about validity need to be addressed. Research indicates that adequate and representative task sampling, reliable judging and rating of student performances, fairness and equity of the tasks chosen, and the sampling context are among the concerns that may need attention. Science educators tend to give some consideration to basic utility and practical concerns when adopting and using performance assessments but they also need to go further and give attention to the validity of the assessments. This means more attention should be given to the particular tasks sampled, the particular methods used to assess student performance, the conditions under which students are to perform the tasks, and the reliability of the scoring. There are also indications that larger numbers of tasks are needed to enable valid generalizations about achievement.

## Environmental Science

ENRICHMENTS OF SOME MEMBERS OF THE MICROBIAL CONSORTIUM KNOWN AS BLACK-BAND DISEASE INFECTING STONY CORALS ON THE FLORIDA REEF TRACT. G. Getsinger, R. Jonas, Dept. of Biol., George Mason Univ., Fairfax, VA, 22030, and D.J. Ellis\*, Smithsonian Inst., Washington, D.C. One of the most significant threats to coral reef ecosystems and the biological diversity they support is the proliferation of coral diseases. First seen in the Western Atlantic during the 1970's, coral disease is now reported world-wide. Diseases have left 10 percent of the world's coral reefs dead or severely damaged and another 30 percent in critical danger. One of these coral diseases found globally, Black-Band Disease (BBD), is a consortium of metabolically diverse bacteria, forming a microbial mat. The BBD mat moves over the surface of the coral, killing the polyps. Infected corals are identified by a dark band on the coral which leaves the bare white carbonate skeleton, while the tissue in front of the mat appears normal in color and morphology. BBD affects a variety of hard corals including *Diploria*, *Colpophyllia*, *Montastrea*, and *Siderastrea*. The BBD mat microflora produce steep oxygen and sulfide gradients which migrate vertically with diel cycles. Necrosis is presumed to be induced by microbial production of H<sub>2</sub>S in the anoxic zone at the bottom of the microbial mat which abuts the coral tissue. The members of the BBD consortium which have been identified are the cyanobacteria *Phormidium coralyticum* and *Spirulina* sp., and a sulfur-oxidizing bacterium, *Beggiatoa*. Our recent metabolic and microscopic analysis of cultured and partially purified samples of BBD mat collected near Sombrero Reef in the Florida Keys in August, 1997 indicate that the BBD consortium there includes sulfate and sulfur reducing bacteria as well as other reductive metabolic types. Growth has been observed in anoxic enrichment media with, Sulfate, Sulfur, AQDS and Iron, as terminal electron acceptors with Hydrogen gas, Lactate and Acetate alternately as an energy source. Further sample collection and more extensive comparative analysis of the BBD consortium is ongoing.

## Geography

REMOTE SENSING AND GIS TOOLS FOR SPATIAL PLANNING ON VIRGINIA'S EASTERN SHORE. Thomas R. Allen, Jr., Dept. of Political Science & Geography, Old Dominion University, Norfolk, Va. 23529-0088. The Eastern Shore of Virginia has seen four centuries of extensive human impacts on the landscape and underdevelopment in recent decades owing to isolation, out-migration, and limited economic opportunities. This project sought to integrate diverse resources in a framework and associated database and tools for local and regional planning.

A geographic information system (GIS) is used to integrate diverse socio-economic, cultural, and environmental data sets for spatial analysis, display, querying, and mapping of landscape data. Pivotal database layers include Census TIGER and demographic data, land-use and land cover, soils, digital terrain data, natural resources, and ecologically important areas. Multitemporal analysis of land cover change using digital Landsat satellite data from the 1973-1993 documented trends in land use and provided linkages to watershed models of potential pollution sources and sinks. Spatial analyses of land use highlight the need for aquifer protection, woodland corridor preservation, and shoreline and riparian buffer maintenance. (Supported by U.S. Geological Survey Data Grant and Old Dominion Univ.)

AN EVALUATION OF SPACEBORNE RADAR TEXTURE ANALYSIS FOR LAND COVER MAPPING. Matthew A. Bechdol, Department of Geography and Earth Science, MS1E2, George Mason University, Fairfax VA 22030. An ever-present need of all governments is the characterization, quantification and up-to-date accounting of existing natural resources. This is often conducted via land cover mapping, and remote sensing is beginning to play a larger role in these efforts. This study investigated first, the ability of radar to classify broad areas of agriculture and natural vegetation in subtropical environments. Second, this study analyzed the value of radar texture extraction and other image processing techniques to assist the delineation of these land covers with spaceborne radar imagery. The goal of this study is to better understand the capabilities of spaceborne imaging radar through textural measures. The objectives of this research are to 1) evaluate potential texture measures for land cover mapping, 2) perform classifications of the radar imagery through assistance of these measures, and 3) compare and contrast the results of this methodology with traditional digital classification efforts.

SPATIAL PATTERN OF SOUTHERN PINE BARK BEETLE INFESTATION: AN ANALYSIS OF VEGETATIVE CHANGE ON CHINCOTEAGUE ISLAND NATIONAL WILDLIFE REFUGE. Rhonda D. Maluia, Dept. of Political Science and Geography, Old Dominion Univ., Norfolk, VA. 23529. The decline of *Pinus taeda*, due to Southern Pine Bark Beetle infestation, is an ongoing problem at Chincoteague Island National Wildlife Refuge, located on Assateague Island, Virginia. This paper, through the use of multispectral digital images, provides insight into factors that render the trees more susceptible to bark beetle infestation. The use of remote sensing enables the researcher to perform analysis and highlight specific spectral bands, to aid in the identification of vegetative change over large areas. Furthermore, the use of multirate digital images allows the researcher to analyze change over a period of time. By utilizing a band ratio technique called Normalized Difference Vegetation Index one is able to spatially view changes in tree health. The results of this project indicate that a key link exists between physical changes in barrier island morphology and the current decline in *Pinus taeda* located on Assateague Island.



LANDSCAPE EPIDEMIOLOGY INDICATORS OF ARBOVIRAL ACTIVITY: CYCLES OF ENCEPHALITIS IN VIRGINIA. C. John Neely, Virginia Dept. of Health, Norfolk/Old Dominion Univ., Norfolk, Va. 23508. Global and regional outbreaks of vector-borne disease have placed renewed emphasis on the importance of *Sentinel and Predictive Sentinel Surveillance*. Areas in Virginia selected for this study include barrier island, coastal and mountain environments. Recent outbreaks of Eastern equine encephalitis in Tidewater and the Eastern Shore, and LaCrosse encephalitis in southwestern Virginia have emphasized the vulnerability of human populations. Similar outbreaks of vector-borne disease have affected the mid-Atlantic states. Each area has undergone periodic outbreaks of encephalitis, resulting in human morbidity and mortality. A regional surveillance program uses the tools of Remote Sensing, GIS and Medical Geography to analyze the ecologies of encephalitis incidence. These ecologies are characterized to identify component nidality of disease; pathogen, reservoir, vector and terminal host. The site characteristics are classified by vegetation index, hydrology, soils, climate, exposure and slope. This technology is now being employed in a study of vectors and viruses existing in the Great Dismal Swamp. Classifications are geocoded into a Geographic Information System utilizing site sampling and remote sensing to generate thematic layers of spatial data. These layers provide spatial correlations of areas where component nidality for disease exists, or may epizootically occur. The implementation of a regional sentinel surveillance system with a complementary array of satellite sensor data will provide early warning of disease threat and allow control measures to interrupt the cycle of disease transmission, minimizing human risk.

SPATIAL AND STATISTICAL ANALYSIS OF PRECIPITATION PATTERNS IN THE UNITED STATES: 1931-1996. Susan Vidal & Richard Diccchio, Dept. of Geography and Earth Science, George Mason University, Fairfax, VA 22030. The purpose of this research project is to develop and use practical techniques for the analysis of precipitation data on a regional scale to aid in the detection of spatial and temporal climatic patterns. A total of 41 fairly evenly distributed U.S. sites were selected from monthly and annual precipitation data produced by the National Climatic Data Center. Initial statistical analysis showed a slight upward trend in precipitation during the period studied at most sites as well as significant temporal autocorrelation at 13 years for many sites and at 8 and 9 years for some sites. Standardized precipitation data was mapped as a statistical surface for all study years. An ordered site of these shows the progression of precipitation events from 1931 through 1996. A technique that summarizes precipitation information for every site, for all years was developed. This method uses all available information, without requiring the imputing of missing information to complete the analysis. The values obtained enable identification of anomalous and average precipitation years over the entire time period. Mapping anomalous years revealed a general trend toward an increase in wet events, but as yet, no strong patterns have been found when these maps are compared with indices of ENSO and NAO activity. Future activities will include using similar techniques to investigate seasonal data. Further statistical inquiry including principal components and spectral analysis will also be pursued.

ANALYZING THE SPATIAL DISTRIBUTION OF WEST SOUTH CENTRAL AND SOUTH CENTRAL UNITED STATES MEAT GOATS. Stephen E. Wright, Center for Geographic Information Science, James Madison University, Harrisonburg, Va. 22807. The purpose of the study was to identify factors that contribute to the varied location of meat goats in the West South Central and East South Central regions of the United States. This was done by examining how "estimated market value of land and buildings-average dollar value per acre", "average total sales per farm", "average size of farm", and "operators principal occupation farming", relate to the spatial distribution of meat goats. Multiple regression analysis was the statistical technique selected for analyzing the data. The Results indicated that none of the selected variables were adequate predictors of the spatial distribution of meat goats. Furthermore, the overall regression model did not explain the spatial distribution of West South Central and East South Central meat goats.

## Geology

QUARTZ WEATHERING CHARACTERISTICS OF MAURY RIVER TERRACES, ROCKBRIDGE COUNTY, VA. Gregory C. Bank and Dr. David Harbor, Dept. of Geology, Washington and Lee Univ., Lexington, VA. 24450. Incision rates for the Maury River basin are not well documented. We developed a qualitative evaluation of the weathering characteristics of quartz grains obtained from the B horizon of terraces along the Maury River, suggesting a two-part incision history for the terrace chronosequence. Samples came from the floodplain, two intermediate terraces and a topographically inverted terrace 60 m above river level. Results of the scanning electron microscopy study indicate that the highest terrace has gone through a much longer period of weathering than its topographically lower counterparts. The weathered grains are etched and pitted while the other three still possess relatively fresh faces and display discernable conchoidal fracture. Changes in weathering with elevation suggest that the highest terrace is part of the original "valley surface" cut through and disassembled by the Maury River during more recent, rapid incision.

CHEMICAL AND DISCHARGE CHARACTERISTICS OF SIX LARGE LIMESTONE SPRINGS IN THE CENTRAL SHENANDOAH VALLEY. D. K. Barnes and W. C. Sherwood, Dept. of Geol., James Madison Univ., Harrisonburg, Va. 22807. Six large limestone springs, Massanetta, Bear Lithia, Dice's, Blue Hole, Seawright, and Spring Creek were sampled bimonthly for chemical analyses from March through February 1997-98. In addition, discharge for each spring was measured once during the winter months. Water chemistry shows that the springs fall into two distinct groups. Massanetta, Dice's, and Seawright springs are characterized by high levels of total dissolved solids (TDS) in the range of 6-8 Meg/L. In contrast, Bear lithia, Blue Hole, and Spring Creek springs exhibit significantly lower TDS, in the 2-3 Meg/L range. In all cases calcium and magnesium were the major cations and bicarbonate the major anion. The springs exhibiting high TDS are located near the center of the limestone Valley while the low TDS are located near siliceous gravel deposits carrying high purity water from the nearby mountains. Comparisons with the water chemistry with 1928 results are difficult due to vast improvements in today's analytical methods. However, it does appear that sulfide and chlorite levels have increased, probably due to increased anthropogenic additions. Discharge measurements exhibited no clear trends when compared to historical data.

FLOODPLAIN STRATIGRAPHY OF THE MAURY RIVER, ROCKBRIDGE COUNTY, VA. John Benazzi and Dr. David Harbor, Department of Geology, Washington and Lee University, Lexington, VA. During the past two hundred years, the Maury River watershed in Rockbridge County has been extensively developed. Construction of roads and the expansion of cities has increased runoff and sediment supplied to the Maury River, changing the hydraulics and increasing flood frequency, and flood magnitude. These changes have destabilized the present floodplain. The active floodplain has been deposited historically (about 100 years). The major floods of the recent past can be seen within the soil horizons of the present day floodplain.

ON THE OCCURRENCE AND ORIGIN OF GARNET IN THE SOUTH HILL PLUTON, MECKLENBURG COUNTY, VA. C. Michael Breeding and Brent E. Owens, Dept. of Geology, Col. of William & Mary, Williamsburg, VA 23187. The South Hill pluton is located in the Piedmont Province of SE Virginia, and is presumably Alleghanian in age. This elliptical-shaped body ranges from porphyritic biotite granite to biotite-muscovite + garnet granite to muscovite-garnet granite. The porphyritic biotite granite occurs in the N part of the pluton, and the muscovite-garnet granite in the SE. The biotite-muscovite + garnet granite forms an irregular transition zone between the two. Most of the granite is undeformed, but it is locally foliated near contacts. Xenoliths are rare, but larger exposures of muscovite schist within the pluton may represent roof pendants. SiO<sub>2</sub> concentrations range from 70 to 76 wt.% (8 samples), with the muscovite-garnet granite having the highest values. All of the granite types are peraluminous, with A/CNK ranging from 1.06 to 1.17. However, garnet is largely restricted to the muscovite-garnet granite. Garnets from this granite are small (0.2-4.8mm), anhedral, inclusion-rich, uniformly distributed (<0.5 vol.%), and appear to be magmatic in origin based on shape, inclusions, and grain size. A mechanism for garnet formation due to Al-enrichment from assimilation of local country rock is unlikely. Specifically, the garnet-bearing rocks contain lower Al and higher Si than the non-garnet-bearing rocks. Alternatively, enrichment of the pluton in Mn by differentiation is a plausible garnet formation mechanism. Molar MnO/(FeO+MgO) values <0.04 for the biotite-rich granites and >0.04 for the muscovite-garnet granite support garnet formation due to Mn-enrichment. Differentiation proceeded from biotite granite, through the transition zone, to muscovite-garnet granite in the reaction: biotite + MnO, Al<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub> (from liquid) → garnet + muscovite. Thus, the South Hill pluton appears to be a differentiated body with garnet restricted to the most differentiated part.

DESIGN AND DEVELOPMENT OF MULTIMEDIA TEACHING/LEARNING MODULES FOR COLLEGE-LEVEL MINERALOGY: AN INTERACTIVE CD-ROM APPROACH. Brendan T. Cox and Parvinder S. Sethi, Dept. of Geol., Radford Univ., Radford, VA 24142. Mineralogy forms an integral component of undergraduate geology programs across our nation. Learning mineralogy requires mastery of a variety of skills such as spatial visualization and familiarity with physical, mathematical and chemical concepts. It is the authors' hypothesis that use of multimedia, interactive teaching techniques can help enhance comprehension of this subject by students. This paper presents the process of developing an introductory-level, interactive, multimedia CD-ROM designed for use as an instructional aid in class. Examples of key interactive and learning features will be presented and include - macro and close-up images of the minerals, digitized video clips of rotating minerals, use of hyper-linked buttons to aid in pronunciation of mineralogical names, slide shows for review purposes, interactive tests, instant access to a database of minerals, and the overall ease of navigation to text screens containing information concerning- mineral chemistry, physical properties, occurrence in the world, identification tests, and economic uses.

RESPONSES OF BENTHIC FORAMINIFERA TO HISTORICAL CHANGES IN DISSOLVED OXYGEN AND SALINITY IN THE MESOHALINE CHESAPEAKE BAY. Alexander W. Karlsen, Dept. of Biology, George Mason Univ., Fairfax, VA 22032; T. M. Cronin\*, USGS, Reston, VA 220192, Jack McGeehan, USGS, Reston, VA 220192, D. A. Willard, USGS, Reston VA 220192. A detailed temporal record of changes in bottom water environmental parameters of the Chesapeake Bay was developed from microfauna occurring in sediment cores. Piston/gravity cores were taken in approximately 10-25 meters of water depth in the lower Patuxent River, lower Potomac River, and the main stem of the Chesapeake Bay. Relative abundances and ecophenotypic responses of benthic foraminifera (*Ammobaculites crassus*, *Elphidium excavatum*, *Ammonia parkinsoniana*) from sediments were used as bio-indicators of bottom water trends in paleosalinity and paleoanoxia. Radiometric <sup>14</sup>C and pollen dating techniques were used to date core sediments.

Based on the ecophenotypic responses of the foraminifers *Elphidium* and *Ammonia*, our results show a reduction in bottom water salinities at 5-25 meters water depth in the mesohaline Bay since 1840 AD. We have also determined that levels of paleoanoxia in this same region, based on the patterns of shell preservation of foraminifera in the deep-channel core sequences, has reached unprecedented levels over the last 150 years.

CHANNEL MANAGEMENT HISTORY AND IMPLICATIONS FOR CHANNEL STABILITY, SOUTH RIVER, ROCKBRIDGE COUNTY, VA. David P. Ledlie\*, Dept. of Geology, Washington and Lee Univ., Lexington, VA 24450, & Dr. David Harbor, Dept. of Geology, Washington and Lee Univ., Lexington, VA 24450. I argue that the man made changes have a negative impact on the flow velocity, sediment load, channel width, and depth of the river. I examine flood control projects undertaken over the past several years, such as the Vesuvius project sponsored by Rockbridge County and other projects sponsored by the Natural Resources Conservation Service. The ability of the river to effectively transport sediment is drastically altered, demonstrated by the elevated point bars in the normal flow channel. The inability of the South River to effectively transport sediment results in the clogging of the river channel, ultimately increasing the probability of future high water events. Other options for flood plain management include moving property away from the river, and restoring the flood plain to its natural state.

VARIABILITY WITHIN A MAPPED UNIT OF FREDERICK-LODI SOIL. G. A. Raggambi and W. C. Sherwood, Dept. of Geol., James Madison Univ., Harrisonburg, Va. 22807. Due to a number of factors, including bedrock geology and topography, Virginia soils tend to be highly variable. Even the detailed soil maps (usually a series) used in county soil survey reports, include small area of soils exhibiting other characteristics. In order to evaluate the variability within a unit mapped as Frederick-Lodi series, two plots (approximately 1.3 acres each) were chosen in the Paul State Forest in Rockingham County, Virginia. Detailed boundary surveys and topographic maps were prepared. A table of random numbers were used to locate 30 auger stations in each plot. Data from Plots 1 and 2 showed 11 and 13 profiles (37% and 43%) of non-conforming soils respectively. Most of the non-conforming soils were sands or silt loams with a highly resistant horizon at approximately 27 inches. These soils differ significantly from the deep, red, clayey Frederick-Lodi soils. In Plot 1, a rough topographic control is indicated with the non-conforming profile located on the lower slopes. Plot 2 shows a greater variability of soil types with no clear delineation between conforming and non-conforming profiles. Plot 2 also shows a greater number of wind downed trees with shallow root development. The variability of these residual soils is interpreted to be related to the varying lithology of the underlying source-the Conococheague Formation. The Conococheague is an upper Cambrian carbonate unit containing significant beds and lenses of quartz sandstone.

GROUNDWATER CONTAMINATION AND METAL-OXIDE MINERALS IN A COASTAL PLAIN SANDY AQUIFER. Andrew Thompson and Dr. Elizabeth Knapp, Dept. of Geol., Washington and Lee University, Lexington, Va. 24450. The study of aquifer sands in a non-contaminated surficial aquifer near Oyster, Va. Has shown that ferric iron,  $Fe^{3+}$ , will coat silica sand grains thus changing the surface charge from negative to positive. However, under organically contaminated conditions, where all the oxygen has been depleted by bacterial consumption, the bacteria must use other chemical constituents such as ferric iron as electron acceptors. This reduction of ferric iron to ferrous iron,  $Fe^{2+}$ , causes the iron coating the silica surface to dissolve in the groundwater and alters the surface chemical properties of the sand grains. Scanning electron microscopy was used to observe the nature of the silica grains and their ferric iron coatings. In anaerobic sediments, the surfaces of the sand were observed to be devoid of ferric iron. These results would suggest that anaerobic conditions have altered the aquifer mineralogy. The characteristics of these aquifer sediments have implications for the sorption of reactive contaminants traveling through these sands.

FIRE-BAKED PALEOSOLS AT JOCKEYS RIDGE, NORTH CAROLINA. G. Richard Whittecar, Daniel M. Holloway, and Shonia Becraft\*, Dept. of Ocean, Earth and Atmos. Sci., Old Dominion Univ., Norfolk, Va. 23529. Exposures of a buried soil visible in many eroded dunes at Jockeys Ridge State Park, N.C. reveal topsoil horizons charged with abundant charcoal fragments. Incipient "color B" subsoil horizons (10YR3/2) have stronger coloration than both thinner paleosols on neighboring Run Hill dune and thicker Spodic Quartzipsamments on older beach ridge dunes on Collington Island. Several charred *in situ* tree stumps occur within the Jockeys Ridge buried soil; one has vitrified, bubbly glass around its roots and notably more intense oxidized colors (e.g. 7.5YR4/4 to 5/6) in the surrounding sand. Laboratory experiments indicate that sandy soils from the A, B, and C horizons of the Jockeys Ridge paleosol increase in soil color intensity when heated to temperatures between 300°C and 700°C. The greatest change of colors (e.g. 10YR2/2 to 7.5YR5/8) occurs between approximately 350°C and 550°C, depending upon the iron and humus content of the horizon. These observations plus several radiocarbon dates suggest that the buried soil beneath Jockeys Ridge formed beneath a forest on dunes that were undulating but not unusually tall. Approximately 200 years ago, soils around at least one tree were heated to as much as 450°C by either fire or lightning. Although more extensive anomalous colors in the paleosol might be related to very shallow baking from an intense fire, the small fuel supply typically present within maritime forests probably could not generate high temperatures in the soil.

A PETROLOGICAL RECONNAISSANCE OF METAMORPHOSED ULTRAMAFIC ROCKS, BUCKINGHAM COUNTY, VA. Natalie E. Uchner and Brent E. Owens, Dept. of Geology, College of William & Mary, Williamsburg, VA 23187. Numerous occurrences of metamorphosed ultramafic rock are reported throughout the Piedmont Province of VA, but such rocks have not been studied beyond the mapping stage. The origin and tectonic significance of these rocks are unclear – they could, in some cases, represent portions of ophiolite suites. The purpose of this study was to investigate in detail the mineralogy and chemical compositions of a series of ultramafic occurrences across a relatively small area in order to provide constraints on the nature and origin of their protoliths. A variety of rock types are recognized: serpentinite, chlorite schist, talc schist, talc-carbonate rock, and chlorite-actinolite schist. Some localities contain more than one rock type. Major element compositions (10 samples) show a remarkable range in SiO<sub>2</sub> (27-60 wt%), Al<sub>2</sub>O<sub>3</sub> (1-20 wt%), and CaO (0.1-9 wt%). Much of this variation reflects relative amounts of chlorite and actinolite. Concentrations of MgO are high (20-36 wt%), as are X<sub>Mg</sub> values (0.76-0.92). All occurrences probably represent, or are related to metamorphosed ultramafic rocks, but the various rocks originated in different ways. The serpentinite was derived from a harzburgite protolith, which formed part of the Diana Mills mafic pluton (now largely hornblende metadiorite). Chlorite schist, talc schist, and talc-carbonate rock are best interpreted as disrupted fragments of reaction zones between country rock and serpentinite bodies. Thus, these rocks do not preserve their original compositions. On the other hand, chlorite-actinolite schists have bulk compositions consistent with plagioclase-bearing, ultramafic protoliths. Such rocks could be remnants of ophiolite suites, but results from this work do not demand such an interpretation.

## Materials Science

CORROSION PRODUCT FORMATION FROM SHORT TERM ATMOSPHERIC EXPOSURE OF STEEL. Rama Balasubramanian and D. C. Cook, Old Dominion University, Norfolk, VA 23529. The process of formation of corrosion products resulting from short-term exposure of steels as a function of environmental conditions has been investigated. It is known from previous research work on atmospheric corrosion, carried out at Old Dominion University, that corrosion products formed as a result of 16 years of exposure contain goethite ( $\alpha$ -FeOOH) but little or no akaganeite ( $\beta$ -FeOOH). The absence of akaganeite phase in the corrosion products formed from long-term exposure has been a subject of debate, since it is suspected to be one of the earliest oxides to form in environments containing chlorine. The present research has investigated the corrosion products which form for exposure times less than a year, and to determine if akaganeite is present, and if so, correlate the environmental factors influencing the formation of this phase. Carbon steel coupons were exposed at several sites, both marine and near marine, in Mexico where, the atmospheric parameters show that time-of-wetness, and chloride concentrations were higher than normally found in the United States. The corroded coupons were analyzed by Mössbauer, Raman and Infra-Red spectroscopies as well as x-ray diffraction, in order to completely identify the oxides and map their location in the corrosion coating. A predominance of lepidocrocite ( $\gamma$ -FeOOH), and akaganeite was observed in the coatings. The fraction of the akaganeite phase increased at sites with higher chloride concentrations.

MANUFACTURE AND MECHANICAL PROPERTIES OF A HIGH-PERFORMANCE THERMOSETTING POLY(ETHERIMIDE) / CARBON FIBER COMPOSITE. Todd A. Bullions, Dept. of Engineering Science and Mechanics, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061-0219, J.E. McGrath, Dept. of Chemistry, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061-0211, & A.C. Loos, Dept. of Engineering Science and Mechanics, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061-0219.

A phenylethynylphthalic anhydride terminated poly(etherimide) oligomer with a molecular weight of  $M_n = 3,000$  g/mole has been synthesized for use in high-performance composite and adhesive applications. This reactive poly(etherimide) exhibits excellent thermo-oxidative stability and solvent resistance upon curing at high temperatures. Towpreg has been produced by coating unsized, G30-500, 12k carbon fiber tow with this oligomer in a powder form. A minimal dry powder prepregging technique was employed for rapid processing to circumvent the problems associated with high viscosity and to perform the operation in an organic solvent-free environment. This towpreg has been manufactured into flat composite laminates via manual lay up and hot press consolidation and cure. Transverse and longitudinal flexure properties and apparent interlaminar shear strength have been measured and are reported. In addition, the Mode I and Mode II fracture toughness of these composite panels has been investigated via the double cantilever beam (DCB) and end-notch flexure (ENF) test methods. Fracture surface and microstructure features are correlated with the measured mechanical properties.

MAGNETIC AND ELECTRONIC PROPERTIES OF RHODIUM CLUSTERS. Chang-Hong Chien, Estela Blaisten-Barojas, Inst. for Computational Science and Informatics, George Mason Univ., Fairfax, Va. 22030, and Mark R. Pederson, Naval Research Lab., Washington, D.C. 20375-5320. We have used all-electron local (LDA) and nonlocal (GGA) approximations to the density-functional theory to determine binding energies, equilibrium geometries, vibrational frequencies and magnetic properties of  $Rh_N$  clusters ( $N \leq 6$ ). We present careful tests on the  $Rh_2$  dimer which compare results as calculated with a large (18-single gaussian) and a very large (23-single gaussian) basis sets. While the smaller set of gaussians leads to underconverged results, we find that the large basis set leads to converged results which are also in excellent agreement with the experimental data available for  $Rh_2$ . The ground state of  $Rh_2$  is confirmed to be a quintuplet, the trigonal  $Rh_3$  is predicted to be a sextuplet,  $Rh_4$  in its tetrahedral configuration is a singlet,  $Rh_5$  sextuplet is a square pyramid, and  $Rh_6$  septuplet is the octahedron. Results from several excited states are calculated and presented as well. It is found that LDA overestimates the binding energy but that GGA corrects this deficiency and predicts longer bond lengths.

PROTECTIVE RUST LAYERS ON WEATHERING STEEL. Desmond C. Cook and Sei J. Oh, Department of Physics, Old Dominion University, Norfolk, VA 23529. The corrosion products formed on weathering steels exposed in marine, rural and industrial environments in the United States for 16 years have been investigated using Mössbauer spectroscopy, Raman spectrometry, x-ray diffraction and electron-probe micro-analysis. Mössbauer spectroscopy was used to measure the fraction of each oxide in the corrosion coatings, Micro-Raman spectrometry to locate the oxides to  $2 \mu\text{m}$  spatial resolution and EPMA to map the final location of the alloying elements in the corrosion coating. Mössbauer spectroscopy identified the corrosion products as 80% goethite, 15% lepidocrocite and 5% maghemite. Raman analysis showed that the corrosion products generally formed as alternating layers containing different oxides. One type of layer, named the protective inner-layer closest to the steel substrate, consisted of nano-sized goethite ranging in size from 5-30 nm and having a mean particle size of about 12 nm. The other, the outer-layer, close to the coating surface, consisted of lepidocrocite and goethite with the former oxide being most abundant. EPMA showed that chromium from the steel was present only in regions containing the nano-sized goethite, which was always close to the steel substrate. It was concluded that goethite is the final stable oxide to form, and that the inclusion of chromium forms nano-phase goethite which offers further corrosion protection to the steel substrate.

STRUCTURE AND ENERGETICS OF SILICA CLUSTERS. Carlos Cruz, Estela Blaisten-Barojas, Adrian Roitberg\*. Institute of Computational Sciences and Informatics, George Mason University, 4400 University Drive, Fairfax, VA 22030. A simulated annealing method based on Molecular Dynamics was used to find the minimum energy structures of silicon dioxide clusters containing  $N = 1, 2, 3, 4, 5, 6, 8, 12, 18, 24$ , and 32  $\text{SiO}_2$  molecules. The annealed structures were then minimized with respect to the coordinates to obtain the structures of the global minimum and their corresponding energies. All the calculations are based on the interatomic potential of Tsuneyuki et. al. [1] with a short range correction.

THE FORMATION OF GOETHITE ON CORRODED STEEL. Jennifer Gurdak, and Desmond C. Cook. Physics Department, Old Dominion University, Norfolk, VA, 23529. In the corrosion products which form on atmospherically exposed steel, goethite has recently been found to be one important iron oxide which adheres tightly to the steel and helps prevent further corrosion. In order to better understand the formation of the rust layers, it is important to study pure samples of each component. Pure and chromium substituted goethites of particle sizes ranging between 10-200 nm were prepared and analyzed by Mössbauer spectroscopy in order to study the relationship between particle size and chromium concentration. It was determined that pure goethite having particle size greater than 100 nm is magnetic at 300 K but as the particle size decreases and chromium concentration increases, the magnetic field shows superparamagnetic behavior. As the temperature is decreased, the relaxation rate of the sample also decreases, and magnetic order is restored. The temperature and volume dependence of the magnetic field is governed by the relaxation equation:  $\tau \propto \exp(KV/kT)$ .

THE CREEP BEHAVIOR OF  $\text{Al}_2\text{O}_3$ -BASED TOW AND HYBRID FIBERS. Vincent H. Hammond, Frank E. Wawner, and Dana M. Elzey, Dept. of Materials Science and Engineering, Univ. of Virginia, Charlottesville, Va. 22901. The development of fiber bundles, or tows, offers a low cost alternative to monofilaments currently used as reinforcements in composite materials. A potential use for these tows is in composites designed for elevated temperature applications such as the aerospace or power generation industries. In these applications, the most critical property is the ability to resist time-dependent (creep) deformation which occurs at elevated temperatures under sub-critical loading. While some research has studied the creep of monolithic fibers, the creep response of bundles is not well understood. In this presentation, results of creep tests performed on both alumina (Nextel 610) tows and alumina-porous alumina (A-PA) hybrid fibers will be presented and discussed.

COMPUTER SIMULATION OF COLLOIDAL AGGREGATION. Mohammed Lach-hab, Estela Blaisten-Barojas, Inst. of Comp Sci and Inf, George Mason Univ., Fairfax, Va, 22030, and Agustín E. González\* Inst de Física, Univ Nacional Autónoma de México, Apartado Postal 20-364, 01000 México, D.F. By means of extensive numerical simulations and by different procedures, we calculate the cluster fractal dimension ( $d_f$ ) of colloidal aggregates at different initial colloid concentrations. Our first approach consists in obtaining  $d_f$  from the relation between radius of gyration and size of all the clusters formed during the aggregation time. In the second and third procedures  $d_f$  is obtained via the particle-particle correlation function  $g_{cluster}(r)$  and the structure function  $S_{cluster}(q)$  of individual clusters and of the whole system, respectively. It was found the the concentration dependence of the fractal dimension  $d_f$ , using the correlation functions for individual clusters, agrees perfectly well with that from the radius of gyration versus size. However, the structure factor  $S(q)$  of the whole system is not the correct function to use when trying to obtain a cluster fractal dimension in concentrated suspensions. The log-log plots of  $S(q)$  vs  $q$  always proportion a value higher than the true value. It is shown that the true value can be obtained from the slope of the particle-particle correlation function  $g(r)$  at short distances.

MOLECULAR DYNAMICS STUDY OF THERMAL CONDUCTIVITY IN TWO- AND THREE-DIMENSIONAL SOLIDS. Alexandra Landsberg and Estela Blaisten-Barojas, Institute for Computational Sciences and Informatics, George Mason Univ., Fairfax, VA, 22030. The thermal conductivity of two- and three-dimensional solids was simulated using the Green-Kubo equilibrium approach and Molecular Dynamics (GKMD). In addition, the thermal conductivity of two-dimensional solids was studied using a non-equilibrium Molecular Dynamics approach (NEMD). In the GKMD formulation the thermal conductivity is expressed in terms of the autocorrelation function of the heat current operator. The non-equilibrium approach obtains the thermal conductivity from an atomistic simulation of the steady state of heat conduction in a solid not at thermal equilibrium. When the steady state of a non-equilibrium system is reached, the time-averaged heat current is constant throughout the system. In these simulations, the GKMD approach requires fewer atoms and tends to have smaller errors than the NEMD approach. However, the GKMD approach is limited to homogeneous systems while the NEMD approach is not. Hence while the NEMD approach is computationally more expensive, it is a powerful method to study more complex systems.

MODELING THE EQUILIBRIUM SHAPE AND SINGLE ORIENTATION VARIANT OF INTERPHASE BOUNDARY PRECIPITATES Weigang Meng and Gary J. Shiflet\*, Dept. of Materials Science and Engineering, Univ. of VA, Charlottesville, VA 22903.

The equilibrium shape of nuclei at interphase boundaries is modeled through minimization of interfacial energy under the assumptions of a rigid planar interphase boundary (IPB) and constant volume constraint. The nucleus equilibrium shape is also graphically derived by a modified Wulff construction. The current model predicts that the IPB nucleation activation energy increases with the nucleus faceting angle  $\phi$ , the angle between the nucleus facet plane and the interphase boundary plane. Therefore, it is energetically favorable for the nucleus facet to lie as parallel as possible to the interphase boundary plane. The model provides theoretical rationalization to many experimental observations made on IPB precipitation that only one of the several possible orientation variants is adopted between the IPB precipitates and one of the matrix phases. (Supported by National Science Foundation)

SYNTHESIS AND CHARACTERIZATION OF Ta-DOPED  $K_6Ti_5Nb_6O_{28}$ . Gerald L. Roberts<sup>1</sup>, Kimberly A. Baldwin\*<sup>1</sup>, Darren S. Dale\*<sup>1</sup> and Alejandra Echezuria\*<sup>2</sup>, <sup>1</sup>Dept. of Chemistry, George Mason University, Fairfax, VA 22030; <sup>2</sup>Dept. of Chemistry, The George Washington University, Washington, DC 20052. The results of the synthetic efforts toward single phase  $K_6Ti_5Nb_{6-x}Ta_xO_{28}$ , the potassium analogue of  $Ba_3Ti_5Nb_6-xTa_xO_{28}$  (room temperature  $K \approx 28$ , TCK  $\approx -21$  ppm/ $^{\circ}C$ ), via conventional solid state synthesis are presented for several potassium titanium niobium tantalum oxides (for  $x = 0, 0.2, 0.4, 0.8, 1.0$ ). It has been previously demonstrated the relative dielectric constant (K) and the temperature coefficient of the dielectric constant (TCK) can be modified for various oxides via doping with  $Ta_2O_5$  and  $Al_2O_3$ . The investigation of these compounds (single phase) as potential dielectric materials, relative to the Ba-3-5-6 compound will be explored. In addition, the determination of the limits of the solid solution for a series of  $Sr_{3-x}Na_xNb_4TaO_{15}$  compounds and the lattice parameters for the stoichiometric compounds will be presented.



## CHROMATOGRAPHIC ANALYSIS OF HIGH PERFORMANCE RESINS.

Philip R. Young and Jennifer H. Brown, Department of Chemistry, Emory & Henry College, Emory, VA 24327, and Harold M. McNair, Department of Chemistry, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061. A reverse phase High Performance Liquid Chromatographic method was developed to rapidly fingerprint the quality of a phenol-formaldehyde resole resin similar to the system used in fabricating carbon-carbon composite materials. Knowledge of resin chemistry is essential to successful processing. The results indicate that a non-linear water-methanol-acetonitrile gradient using a 150 x 4.60 mm, 5  $\mu$ m, 100 angstrom, C<sub>8</sub> bonded column enabled the separation of over 40 resin components in less than 25 minutes.

## Medical Science

STRUCTURE-ACTIVITY RELATIONSHIPS OF  $\Delta^8$ -TETRAHYDROCANNABINOL ANALOGUES AT THE CB<sub>2</sub> RECEPTOR. Mie Mie Aug, Billy R. Martin, Mary E. Abood, Dept. of Pharm. and Tox., Medical College of Va., Va. Commonwealth Univ., Richmond, Va., 23298, & John W. Huffman, Dept. of Chem., Clemson Univ., Clemson, South Carolina 29634-1905. The active constituent of cannabis,  $\Delta^9$ -tetrahydrocannabinol, produces many complex pharmacological effects such as analgesia, anti-emesis and immunomodulation. The mechanism of action of cannabinoids is thought to be mediated by two cannabinoid receptors, CB<sub>1</sub> and CB<sub>2</sub>. CB<sub>1</sub> is located predominantly in the central nervous system and CB<sub>2</sub> in the periphery. A pharmacophore model for the association between the ligand and the CB<sub>1</sub> receptor has been proposed for compounds bearing structural similarity to THC: A free phenolic hydroxyl at C1, an alkyl side chain of at least three carbons at C3 and steric constraints at C9. The purpose of this study was to identify cannabinoids displaying selectivity for the CB<sub>2</sub> receptor and to examine the effects on CB<sub>1</sub> and CB<sub>2</sub> binding by various alterations of this three-point interaction. The binding affinities of a series of  $\Delta^8$ -THC analogues were determined at cloned CB<sub>1</sub> and CB<sub>2</sub> receptors using a radioligand binding assay in a transfected cell system. The results of the study indicate that the conversion of the C3 side chain from a pentyl to a dimethylpentyl increases binding affinity for CB<sub>1</sub> and CB<sub>2</sub>. The subsequent removal of the C1 hydroxyl from either  $\Delta^8$ -THC or from the dimethyl analogue, imparts a 1000-fold and a 30-fold selectivity to the CB<sub>2</sub> receptor, respectively. Furthermore, a shortened C3 side chain (three to five carbons) increases selectivity for CB<sub>2</sub>. In conclusion, the basic  $\Delta^8$ -tetrahydrocannabinol molecule has several targets for structural modification which may be utilised in order to produce selective high affinity CB<sub>2</sub> receptor ligands. (Supported by DA-05274 and DA-03672.)

## RESPONSE OF BRYOSTATIN/IONOMYCIN-ACTIVATED T-CELLS FROM BREAST CANCER PATIENTS TO HER-2/NEU-DERIVED EPITOPES PRESENTED BY CLASS I.

Ankush K. Bansal, Dept. of Biology, & H.D. Bear, Div. of Surgical Oncology, Va. Commonwealth Univ., Richmond, VA, 23298. Bryostatins 1 and ionomycin have been shown to be potent activators of T cells. It has also been shown that some T cells from breast cancer patients recognize and respond to peptide epitopes derived from HER-2/neu, a proto-oncogene that is expressed by 30% of breast cancers. Most of these responses have been HLA-A2 restricted. We sought to detect evidence of a response to HER-2/neu<sup>+</sup> targets by bryostatin/ ionomycin-activated and IL-2-expanded T-cells from the axillary tumor-draining lymph nodes of breast cancer patients. Lymphocytes were tested for cytotoxicity and/or release of TNF-, IFN-, or GM-CSF. Cytotoxicity assays were performed by measuring Cr-51 release from target tumor cells incubated with effector T-cells. Cytokine release was assessed by measuring the amount of cytokine in supernatant fluid from lymphocyte/tumor cell co-culture and standard ELISA procedures. T cells showed no HER-2/neu-specific cytotoxicity against breast cancer cells, regardless of HER-2/neu or HLA-A2 expression. All three cytokine release assays showed no response by the T-cells to any of the breast cancer cell lines. Thus, there does not seem to be a HER-2/neu-restricted response to tumor cells by activated T-cells from breast cancer patients.

ANTINOCICEPTIVE EFFECTS OF OPIOID AGONISTS AND ATP-GATED POTASSIUM CHANNEL OPENERS IN THE MOUSE BRAIN. Alka Bhargava and Sandra P. Welch, Dept. of Pharm./Tox, Va. Commonwealth Univ., Richmond, VA 23298 The ATP-gated potassium channel openers diazoxide (DZ), levcromakalim (Lem) and morphine induce cell hyperpolarization by opening the potassium channels and enhancing potassium efflux. Previous findings implicate the release of endogenous opioids as the mediator of the antinociceptive effects of K<sup>+</sup> channel openers. DZ and Lem, administered i.c.v., produced antinociception as determined by the tail-flick method [ED<sub>50</sub>'s 44 µg/mouse (CL's 28-68) and 171 µg/mouse (partial agonist), respectively]. Glyburide (10 µg/mouse), the ATP-gated potassium channel antagonist, attenuated the effects of DZ, Lem and morphine. DZ- and Lem-induced antinociception were differentially attenuated by opioid-receptor antagonists. Antisense oligodeoxynucleotides to the opioid receptors, which decrease the number of available receptors, were used to demonstrate the involvement of endogenous opioids in DZ- and Lem-induced antinociception. Antisense to all three opioid receptors attenuated the effects of DZ, suggesting that DZ is releasing the endogenous opioids β-endorphin, enkephalins and dynorphins. However, Lem-induced antinociception was antagonized by μ and δ antisense, indicating that only β-endorphin and the enkephalins mediate its antinociceptive effects. This work was supported by NIDA grant #'s DA01647-20 and K02 DA00186-05.

FAS-FAS LIGAND INTERACTIONS MAY REGULATE 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN (TCDD) INDUCED APOPTOSIS IN THYMOCYTES. J. Camacho, P.S. Nagarkatti, Dept. of Biol. and A.B. Kamath, M. Nagarkatti, Dept. of Biomedical Sciences & Pathobiol., VA-MD Regional Col. of Veterinary Medicine, Virginia Tech, Blacksburg, VA 24061. TCDD is a highly toxic environmental pollutant and is shown to cause severe thymic atrophy, although the exact mechanism is not known. Earlier studies from our laboratory have shown that TCDD induces apoptosis in thymocytes and that Fas-deficient mice are more resistant to thymic atrophy induced by TCDD. In this study we found that administration of a single dose of 0.1, 1 or 5 µg/kg body weight of TCDD caused marked thymic atrophy on day 5 in C57BL/6 +/- mice but not in Fas-ligand defective *gld* mice. The Fas-deficient *lpr* mice also failed to exhibit thymic atrophy at these concentrations. Furthermore, TCDD induced apoptosis in thymocytes from wild-type mice but not from *lpr* or *gld* mice. Serum from TCDD-treated mice exhibited high levels of Fas-ligand, inasmuch as, incubation with serum from TCDD-treated mice triggered increased apoptosis in Fas<sup>+</sup> but not Fas<sup>-</sup> L1210 tumor cells. The current study demonstrates that TCDD induced apoptosis in thymocytes may be regulated by Fas-Fas ligand interactions and that TCDD-mediated apoptosis may contribute towards the immunotoxicity seen in activated T cells and thymocytes. (Supported in part by grants from the NSF/EPA and NIH)

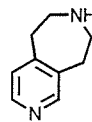
THE EFFECT OF MORPHINE ON ATP-GATED K<sup>+</sup> CHANNELS FOLLOWING TOLERANCE AND WITHDRAWAL. Vera C. Campbell, William L. Dewey, and Sandra P. Welch, Dept of Pharm./Tox., Va. Commonwealth Univ., Richmond, VA. 23298. Potassium plays an important role in setting the cell's resting membrane potential thus regulating ion transport in the cell. Morphine is an ATP-gated K<sup>+</sup> channel opener that hyperpolarizes the cell leading to a decrease in Ca<sup>2+</sup> conductance (entry). These actions produce morphine's antinociceptive effects. Upon repeated administration of morphine, there is a decrease in the efflux of K<sup>+</sup> from the cell, and a compensatory increase in Ca<sup>2+</sup> conductance. Therefore, these actions may contribute to morphine tolerance. Our laboratory has demonstrated that morphine exhibits a modulatory control over the ATP-gated K<sup>+</sup> channel. Thus, this study will evaluate the effect of chronic morphine administration on ATP-gated potassium channels during tolerance and dependence. The effects on the channel were evaluated in mouse spinal cord using the radiolabelled ATP-gated K<sup>+</sup> channel blocker glyburide. Male ICR mice were rendered tolerant to morphine by pellet implantation and the mice were either spontaneously withdrawn for 1, 2, 3, and 10 days from morphine by pellet removal, or withdrawal was precipitated for 6 hours with naloxone (1mg/kg). The results, from previous studies, showed that chronic morphine increased the K<sub>D</sub> by 2.6 fold and the B<sub>max</sub> by 3.4 fold. These changes were transient and returned to placebo levels as early as 6 hours following precipitated withdrawal, and at 24 hours after spontaneous withdrawal. Clinically, this is a benefit to those who chronically use morphine to treat pain because the receptor changes appear to return to normal rapidly following cessation of therapy which would indicate that the changes tolerance produced may not be long lasting. (Supported by NIDA grants R1DA01647, T32DA07027, and K02DA00186.)

THE ORAL ADMINISTRATION OF  $\Delta^9$ -THC FOR PREVENTION OF TOLERANCE TO MORPHINE AND OTHER OPIOIDS. Diana L. Cichewicz and Sandra P. Welch, Dept. of Pharmacology, Va. Commonwealth Univ., Richmond, VA, 23298. Delta-9 tetrahydrocannabinol (THC) is the major component in Marinol, an oral preparation for cancer and AIDS patients to alleviate side effects of chemotherapy and improve appetite. However, oral THC alone has little use as an analgesic because high doses are needed. Previous reports demonstrate that a low inactive dose of THC (20 mg/kg) administered orally to mice enhanced morphine-induced antinociception. The first aim of this study was to determine if other opioids also exhibit an enhanced potency when administered along with a low dose of THC. Codeine, methadone, oxymorphone and hydromorphone all showed significant shifts in ED<sub>50</sub> (potency ratios were 25.8, 4.1, 5.0 and 12.6, respectively) between vehicle and THC pretreatment. Therefore, other opioids similar to morphine exhibit a greater than additive effect with low THC. The second aim of this study was to elucidate the receptors involved in this enhancement. Antagonists to the three types of opioid receptors ( $\mu$ ,  $\delta$ ,  $\kappa$ ) were administered prior to the combination of THC and opioid, and antinociception was again evaluated. Naloxone, a  $\mu$  receptor antagonist, was found to significantly block the THC-induced enhancement of both morphine and codeine. The  $\delta$  receptor and  $\kappa$  receptor antagonists, naltrindole and nor-BNI, respectively, showed differential abilities to block the enhancement effect. We conclude that the  $\mu$  receptor is a critical component of the enhancement of opioids by THC, with the delta receptor possibly playing an indirect role. Binding studies have shown that in chronic morphine tolerance, there is a down-regulation of  $\mu$  receptors in the midbrain of mice and CB1 receptors in the dorsal horn of the spinal cord of rats. We hope to see co-administration of an inactive THC dose yield a decrease or prevention of morphine tolerance, which will be manifested in mice as a lack of the down-regulation of  $\mu$  receptors. Work was supported by NIDA Grants DA07027 and DA05274.

TREATMENT OF MURINE MAMMARY TUMORS USING TUMOR-SENSITIZED LYMPHOCYTES AFTER SORTING AND ACTIVATION WITH BRYOSTATIN 1 AND IONOMYCIN. K. R. Creasy and H. D. Bear\*. Department of Microbiology and Immunology, Medical College of Virginia/ Virginia Commonwealth University, Richmond, VA 23228. Adoptive immunotherapy (AIT) for cancer involves the transfer of activated lymphocytes into a host in order to mediate an anti-tumor response. T-lymphocytes can be activated pharmacologically using Bryostatin 1 (B), a protein kinase-C activator, and Ionomycin (I), a calcium ionophore. Traditionally, AIT has involved weeks of *in vitro* expansion of lymphocytes, a process which is both costly and time consuming. Recent data in our lab have shown that activated lymphocytes ( $5 \times 10^6$  cells) may be transferred into a tumor bearing host immediately after pulsing for 18 hour with B/I and allowed to expand *in vivo* in order to mediate an effective anti-tumor response. Additional data revealed that "memory" (CD45RB<sup>lo</sup>) cells may be responsible for the therapeutic efficacy of tumor-draining lymph node cells (DLN). Using a murine mammary tumor cell line, 4T07, we demonstrated that a lower dose of unseparated DLN cells ( $1 \times 10^6$ ) pulsed with B/I had little anti-tumor effect when combined with a single dose of cyclophosphamide (CYP 100 mg/kg) when treating established intradermal tumors. In contrast, the same number of B/I pulsed cells from the memory cell subset completely eradicated established tumors in conjunction with CYP. In addition, one million separated and pulsed naïve cells (CD44-), from the same lymph node preparation, failed to significantly reduce tumor growth. Our results demonstrate that immediate transfer of a small number of activated memory subset cells largely accounts for the therapeutic effect of DLN cells in mediating tumor regression.

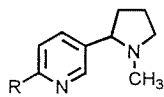
AMPA RECEPTOR EXPRESSION IN HIPPOCAMPAL REGIONS FOLLOWING CENTRAL FLUID-PERCUSSIVE BRAIN INJURY. S.M.DeFord, R.J.Hamm\*, D.L.Buck\*, L.L.Phillips\* & M.L.Giebel\*. Department of Psychology and Division of Neurosurgery, Virginia Commonwealth University/Medical College of Virginia, Richmond, VA 23298-0693 USA. Alterations in  $\alpha$ -amino-3-hydroxy-5-methyl-4-isoxazolepropionate (AMPA) receptors (1-4) have been implicated in ischemia and epilepsy. Following global ischemia, GluR2 gene expression is decreased and AMPA receptor-mediated Ca<sup>2+</sup> influx increased (Gorter, et al., 1997). Hypoxic-ischemic basal ganglia necrosis also results in decreased GluR1, 2/3 and 4 (Meng, et al., 1997). Studies suggest these AMPA receptor and related Ca<sup>2+</sup> flux alterations may be due to differences in regulation of mRNA editing following insult, such as that found by Paschen & Schmitt (1996) following transient cerebral ischemia. Since ischemia and traumatic brain injury share common pathobiology, traumatic brain injury (TBI) might also be expected to produce alteration in AMPA receptor expression. Expression of GluR1 and GluR2/3 in CA1, CA3 and the apex of dentate hilus was assessed 15 days post injury following sham and central fluid percussive injury in rats. Immunohistochemistry methods using polyclonal antibodies specific for GluR1 and GluR 2/3 were employed to determine receptor expression. TBI was associated with a significant decrease in number of cells expressing GluR 2/3 per  $\mu$ m in the CA1 region. No change was found in GluR1 receptor expression following TBI. Ongoing studies are looking at the correlation of improved cognitive performance to the expression of AMPA receptors. Supported by NIH grant N512587

SYNTHESIS AND STRUCTURE-ACTIVITY RELATIONSHIPS OF NOVEL NICOTINIC RECEPTOR LIGANDS. Matthew Dowd<sup>1</sup>, Yun-Xing Cheng<sup>1</sup>, Malgorzata Dukat<sup>1</sup>, M. Imad Damaj<sup>2</sup>, Billy R. Martin<sup>2</sup>, and Richard A. Glennon<sup>1</sup>, Depts. of <sup>1</sup>Medicinal Chemistry and <sup>2</sup>Pharmacology & Toxicology, VCU, Richmond, VA 23298-0540. Nicotine has a range of beneficial effects, such as neuroprotection, memory enhancement, and anxiety relief, and toxic effects, such as gastrointestinal disturbances and death. In order to develop agents which may be useful for treating certain diseases, such as Alzheimer's and Parkinson's diseases, we have been examining the molecular features that are required for nicotine receptor binding. Past research in our lab indicated that an internitrogen distance of 5.1 to 5.5 Å may be optimal. With this in mind, 6,7,8,9-tetrahydro-5H-pyrido[3,4-d]zajepine (1), whose internitrogen distance is 5.5 Å, was synthesized. Compound 1 was shown to have improved affinity ( $K_i = 46$  nM) over an isomeric pyridoazepine, in which the internitrogen distance is only 4.6 Å. We also prepared and tested several ring-opened analogs, such as aminoalkyl-, aminopropenyl-, aminopropynyl-, and aminoethoxypyridines. Because parallel changes in the nitrogen substituents of these analogs did not result in parallel changes in affinity, it is likely that not all analogs are binding in an identical manner.



(1)

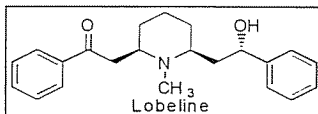
ROLE OF NICOTINE 6-POSITION SUBSTITUENT SIZE AND LIPOPHILICITY ON NICOTINIC CHOLINERGIC RECEPTOR BINDING. Matthew Dowd<sup>1</sup>, Mohamed El-Zahabi<sup>1</sup>, M. Imad Damaj<sup>2</sup>, Billy R. Martin<sup>2</sup>, Richard A. Glennon<sup>1</sup>, and Malgorzata Dukat<sup>1</sup>. Depts. of <sup>1</sup>Medicinal Chemistry and <sup>2</sup>Pharmacology & Toxicology, VCU, Richmond, VA 23298-0540. Nicotine binds with high affinity to nicotinic acetylcholinergic receptors, which have been implicated in a variety of physiological and pathological processes, including Alzheimer's, Parkinson's, and Tourette's syndrome. To assist in the development of analogs which retain nicotine's beneficial effects, such as cognitive enhancement and anxiety relief, but lack its toxicities, such as addiction, gastrointestinal disturbances, and death, we embarked on a structure-affinity relationship study of nicotine analogs. Earlier work in our lab showed that the electronic ( $\sigma$ ) and lipophilic ( $\pi$ ) characteristics of the 6-position substituent of the pyridine ring may affect affinity. To examine in detail this relationship, we designed, synthesized, and evaluated a series of 6-substituted nicotine analogs. For fifteen of the analogs, it was shown that  $\sigma$ ,  $\pi$ , or the basicity of the pyridine nitrogen (i.e., pKa) could not account for changes in affinity. However, a combination of  $\pi$  and  $\Delta$  MOL VOL (representative of the size of the 6-position substituent) accounted for affinity ( $r = 0.970$ ,  $n = 15$ ). Thus, regarding the 6-position of nicotine analogs, smaller, lipophilic substituents appear optimal for affinity.

6-Substituted  
Nicotine Analogs

DIFFERENTIAL MODULATION OF DYNORPHIN RELEASE BY ISOMERIC CANNABINOIDS. Micah Exls and Sandra P. Welch, Dept. of Pharm./Tox., Va. Commonwealth Univ., Richmond, VA. 23298. Previous studies have shown that various cannabinoids induce an antinociceptive effect in rats. The concentration levels of dynorphin A, dynorphin B, or both seem to play a role in the mechanisms that cause the antinociceptive effect seen in rats after the intrathecal (i.t.) administration of various cannabinoids. Also, investigations have examined receptor modulation. The use of SR141716A, which is a CB1 receptor antagonist, before the administration of various cannabinoids i.t. blocks the antinociceptive effects and dynorphin A release. It was concluded that the release of dynorphins is receptor-mediated by the CB1 receptor. The following studies further investigate if dynorphin release is receptor-mediated by the CB1 receptor by examining the stereoselectivity of two isomeric cannabinoids: levonantradol (levo) and dextronantradol (dextro). Initial studies showed that levo (1 $\mu$ g/rat) produced a 2-fold increase in dynorphin B release [8.05  $\pm$  2.4 pg/ml versus 4.04  $\pm$  0.8 pg/ml for DMSO vehicle]. Dextro (30 $\mu$ g/rat) not significantly alter the concentrations of dynorphin B. The dynorphin B release coincided with %MPE values [DMSO 5%; levo 82%; dextro 5%]. Current studies have increased the amount of levo to 5 $\mu$ g/rat, and both dynorphin A and dynorphin B levels are being examined. The results of the dynorphin A and dynorphin B concentrations are currently being determined. However, it is expected levo will cause a significant release of dynorphin A, dynorphin B, or both. Levo produced an antinociceptive effect at 72 $\pm$ 11%MPE and 82 $\pm$ 11%MPE, while dextro failed to produce an effect. The completed data may suggest that levonantradol and dextronantradol produce stereoselective effect on dynorphin release, which would support that dynorphin release is receptor-mediated. Work supported by K02DA00186 and DA05274.

BIOLOGICAL ACTIVITY OF VARIOUS PHYTOESTROGENS IN CANCER CELL LINES *in vitro*. Mark Elliott, Gary Morris and Roy Williams, Old Dominion Univ. Enological Research Facility, Dept. of Chem./Biochem., Old Dominion Univ., Norfolk, VA 23529. This laboratory has continued to investigate the potential biological activity of various phytochemicals *in vitro*. Phytoestrogens are compounds that exhibit estrogenic or anti-estrogenic activity in hormone dependent cancer cell lines. Our studies have concentrated on the newly recognized anti-estrogenic agent known as trans-resveratrol as well as several of the structurally related stilbene anti-estrogenic agents such as trans-tamoxifen and diethylstilbestrol(DES). We have also examined the activity of the isoflavonoid known as genistein. These compounds have been tested with two human breast cancer cell lines, the estrogen positive MCF-7 cells and the estrogen negative MDA-231 cells. Results from the cytotoxicity studies as well as the growth studies with these agents will be presented. We have recently begun a study with human prostate cancer (LNCap) cells, and will describe the activity of these compounds with this particular hormone dependent cell line.

LOBELINE: STRUCTURE-AFFINITY RELATIONSHIPS FOR CENTRAL NICOTINIC CHOLINERGIC RECEPTOR BINDING. D. Flammia, M. Dukat, M. I. Damaj, B. R. Martin, R. A. Glennon. Depts. of Medicinal Chemistry and Pharmacology & Toxicology, VCU, Richmond VA. 23298. Lobeline has an affinity for central nicotinic receptors comparable to nicotine and, hence, this naturally occurring alkaloid provides a template for the synthesis of novel nicotinic agents. A preliminary structure-affinity study of lobeline has been undertaken in which removal of each side arm or removal of both oxygen moieties was investigated. This showed the importance of the molecule as a whole. Further investigation of each oxygen atom indicates that both are not required for high-affinity binding. Molecular modeling shows that either side arm's oxygen atom can fit into previously defined nicotine pharmacophore models. But, in light of this new information, congruence with this model will require re-evaluation.



INOSITOL PHOSPHATE LEVELS FOLLOWING STRETCH INDUCED INJURY IN ASTROCYTES. Candace L. Floyd, Beverly A. Rzigalinski, Karen A. Willoughby\*, John T. Weber, Therese M. Delahunty\*, Raiford T. Black\*, and Earl F. Ellis\*. Depts. of Psychology, Pharmacology, and Neurosurgery, Medical College of Virginia Commonwealth University, Richmond, VA. A crucial element in the sequelae of pathology following traumatic brain injury is aberrant cell signaling in both neurons and astrocytes. Intracellular free calcium ( $[Ca^{2+}]_i$ ) mobilization mediated by inositol triphosphate ( $IP_3$ ) second messenger activation may significantly effect cell viability as well as neuron-astrocyte communication. Our previous work has shown that  $[Ca^{2+}]_i$  is transiently elevated in astrocytes following stretch injury and that injury may uncouple intracellular  $Ca^{2+}$  stores from  $IP_3$ -mediated signal transduction pathways. To examine the effect of injury on  $IP_3$  levels in cortical astrocytes, we used an *in vitro* model of TBI developed by our lab. Cultured cortical astrocytes were incubated with  $1 \mu Ci$   $^3H$ -myo-inositol, injured, and acid extracted Inositol phosphates were separated on anion exchange columns and counted by liquid scintillation. Stretch injury produced a significant increase over control in  $IP_3$  levels at 5, 15, and 30 minutes post-injury. Additionally, media from injured astrocytes elevated  $[Ca^{2+}]_i$  in neurons, suggesting that  $IP_3$  may be released from astrocytes to affect neuronal  $[Ca^{2+}]_i$ . Thus, the increased  $IP_3$  levels could indicate a deficit in negative feedback for phospholipase  $\gamma$  and  $IP_3$ . Astrocytes may release  $IP_3$  into the neuronal environment disrupting signal transduction pathways and contributing neuron-astrocyte network failure. Supported by NS 7288-11 and NS 272 14

ALTERATIONS IN GLIAL CELLS (ASTROCYTES) MAY ACCOMPANY CHANGES IN REPRODUCTIVE CONDITION IN THE FEMALE RAT. Gifford, G, Quadros, P., \*Lambert, K.G. & Kinsley, C.H. Depts. of Psych., U. of Richmond & \*Randolph-Macon Coll., VA. ). To adequately care for her helpless offspring a newly parturient female must respond virtually immediately with maternal behavior (MB). Both medial preoptic area (mPOA, which regulates MB), and hippocampus (which mediates learning and memory) are capable of hormone-induced plasticity (Keyser et al., 1995; Wooley & McEwen, 1993), the former during pregnancy, the latter, during the estrous cycle. As there are significant alterations of neuronal morphology owing to hormone exposure, what of the neuronal support cells, the glia, which are themselves steroid-sensitive? We examined glial number and morphology in the region of the mPOA in virgin nulliparous (NUL), late-pregnant (LP) and lactating (LAC) female rats. Using immunocytochemistry (ICC) for the astrocytic protein GFAP, we have found large increases in, and marked alterations in complexity of, mPOA glia in LP and LAC females compared to NUL. These data suggest increasing hormone-induced activity in mPOA supporting effective and efficient MB. Together with other data, a picture is emerging of a plastic brain shaped by the experience of pregnancy. (Supp. by NSF & UR research funds.)

#### EVALUATION OF NOVEL NMDA ANTAGONISTS ON PREPULSE INHIBITION OF ACOUSTIC STARTLE.

Sarah A. Harvey, Katherine L. Nicholson, Robert L. Balster, and Jenny L. Wiley. Dept. of Pharmacology and Toxicology, Virginia Commonwealth Univ., Richmond, VA 23298.

Low affinity Phencyclidine (PCP)-site antagonists of the NMDA receptor are being assessed for their therapeutic potential. Unlike the abused drug PCP, they produce fewer adverse effects in humans at therapeutic doses. This larger therapeutic index may be explained by the rapid binding kinetics and unique binding profile of these drugs.

Prepulse inhibition (PPI) is a model of sensorimotor gating, in which a startle response to an acoustic stimuli is reduced by exposure to a weaker lead pulse. Memantine (MEM), lboaine (IBO), Dextromethorphan (DXM), Dextrophan Tartrate (DEXT), and Orphenadrine (ORPH) were studied in the prepulse inhibition model. Male Sprague Dawley rats were placed in a startle chamber after drug treatment and exposed to multiple 120dB[a] pulse alone trials with or without the prepulse.

DEXT, DXM, and MEM exhibited PPI disruption at doses that did not affect startle response. Conversely, IBO and ORPH did not disrupt PPI. The results of this study suggest that DEXT, DXM, and MEM may produce some PCP-like effects at high doses. IBO and ORPH do not appear to disrupt sensorimotor gating and may exhibit fewer PCP-like effects. ( Supported by NIDA grants DA-01442 and DA-07027.)

#### STRESS AND DEHYDROEPIANDROSTERONE. Y.Hu, E.Gursoy, A. Cardounel, and M. Kalimi,

Dept. of Physio., Va. Commonwealth Univ., Richmond, Va 23298. We have examined the role of dehydroepiandrosterone (DHEA) on male Sprague Dawley rats subjected to chronic immobilization stress (2 hours daily for two months). DHEA sc administration (5mg dissolved in 0.1 ml dimethyl sulfoxide/ 250 gm body weight) daily to the immobilization stress animals resulted in almost completely reversed total body weight loss observed by 2 months of chronic immobilization stress. DHEA also protected against elevated lipid peroxidation levels( oxidative damage) in liver, heart and testes observed in immobilization stressed animals. Interestingly, immobilization stressed animals showed significantly higher levels of glucocorticoid receptor(GR) levels in liver, spleen and testes as compared to control unstressed animals and DHEA administration protected rats against immobilization stress-induced total glucocorticoid receptor in liver, spleen and testes. We concluded that DHEA protects against immobilization stress-induced weight loss, in part, by lowering GR and lowering lipid peroxidation in various tissues.

ASSESSMENT OF PROLIFERATIVE AND CYTOLYTIC ACTIVITY OF LYMPHOCYTES IN FISH AND THEIR USE IN IMMUNOTOXICITY. Lisa M. Hudson, Alan G. Heath, Mitzi Nagarkatti, Prakash S. Nagarkatti, Departments of Biology and Biomedical Sciences and Pathobiology, Virginia-Maryland Regional College of Veterinary Medicine, Virginia Tech, Blacksburg, Virginia, 24061.

In recent years there is growing concern about the health status of aquatic species in relation to environmental pollution. Toxic effects on the immune system (immunotoxicity) may serve as an excellent tool and a biomarker to monitor pollution and water quality. Fish immunotoxicology may offer a novel approach to regulate environmental water quality. In the current study, it was hypothesized that the functional tests used to screen the immune system of fish can serve as useful biomarkers to predict environmental pollution. The primary aim of this investigation was to establish functional immune assays in fish. To this end, Tilapia lymphocytes were cultured with T and B cell mitogens such as Concanavalin A (ConA), Phytohemagglutinin (PHA), and lipopolysaccharide (LPS). These mitogens induced strong proliferation in murine lymphocytes but failed to trigger significant proliferation in fish lymphocytes. Interestingly, both fish and murine lymphocytes responded strongly to stimulation with phorbol ester (PMA) and calcium ionophore. When tested for Natural Killer (NK) cell activity, fish lymphocytes exhibited significant cytotoxicity against YAC-1 tumor targets at a level similar to that seen with mammalian lymphocytes. When BCNU, a known immunotoxic drug, was injected intraperitoneally into fish, it caused significant inhibition in the proliferation of fish lymphocytes to stimulation with PMA and calcium ionophore. Together, the current study demonstrates that the immunoassays in fish can serve as a useful tool to screen for immunotoxic environmental pollutants. (Supported in part by grants from EPA, Sigma Xi, and WPI.)

PREPARATION AND FUNCTIONAL EVALUATION OF MUTANT AND WILDTYPE ISOZYMES OF THE MULTIFUNCTIONAL CALCIUM/CALMODULIN-DEPENDENT PROTEIN KINASE, CAMK-II. J. Bradley Hullett & Charlotte A. Willoughby\*. Dept. of Biology, Va. Commonwealth Univ., Richmond, Va. 23284, Robert M. Tombes\*. Massey Cancer Center, Med. Col. of Va., Richmond, Va. 23298. Upon activation by calcium and calmodulin (autophosphorylation) the multifunctional calcium/calmodulin kinase (CaMK-II) phosphorylates many substrates that control mechanisms of metabolism, neurotransmitter release, membrane fusion, gene regulation, and cell cycle control. Mammalian CaMK-II is encoded on four genes ( $\alpha$ ,  $\beta$ ,  $\gamma$ , and  $\delta$ ), and undergoes alternative mRNA splicing, producing over two dozen isozyms. Most of the focus in this lab has been on the  $\beta$  and  $\delta$  isozyms. Immunofluorescence localization has been used to indirectly determine the location of different isozyms within the cell. CaMK-II isozyms were found to be excluded from the nucleus and to have a cytoskeletal association. The constitutively active  $\delta_c$  ( $\delta_c$ -con) and  $\beta_c$ -con isozyms also caused a change in morphology which included the growth of neurite-like processes, particularly in  $\delta_c$ -con. These morphology changes are believed to be associated with the decrease in thymidine incorporation observed for the constitutively active mutants, especially in  $\delta_c$ -con. It is possible these morphology changes are a result of differentiation caused by these overexpressed CaMK-II isozyms. The cytoskeletal association is believed to play an important role in causing this differentiation.

CHARACTERIZATION OF THE PHENOTYPIC ALTERATIONS INDUCED BY TCDD ON THYMOCYTES *IN VIVO* AND ITS EFFECTS ON APOPTOSIS. A.B. Kamath, M. Nagarkatti., Dept. of Biomedical Sciences & Pathobiol., VA-MD Regional College of Veterinary Medicine and P.S. Nagarkatti, Dept. of Biol., Virginia Tech, Blacksburg, VA 24061. 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) has been shown to be a highly toxic environmental pollutant, although the exact mechanism of toxicity is not clear. Recent studies from our laboratory have demonstrated that TCDD induces apoptosis and thymic atrophy in C57BL/6 *+/+* but not in Fas<sup>-</sup> (*lpr/lpr*) or Fas ligand defective (*gld/gld*) mice. In the current study, we compared the phenotypic alterations induced by TCDD in thymocytes of *+/+*, *lpr/lpr* and *gld/gld* mice with the ability of TCDD to trigger apoptosis. In thymocytes of mice treated with a single dose of 50  $\mu\text{g}/\text{kg}$  body weight of TCDD, there was a significant increase in the density of expression of CD3,  $\alpha\beta\text{TCR}$ , CD44 and IL-2R and a decrease in the expression of J11d, CD4 and CD8 molecules when compared to the oil-treated controls. In *lpr/lpr* and *gld/gld* mice, the phenotypic alterations were less marked when compared to the *+/+* mice. Overall, these data suggested that in *lpr/lpr* and *gld/gld* mice which fail to exhibit apoptosis, there were less conspicuous phenotypic alterations when compared to the wild-type mice. Our data also suggest that phenotypic alterations in the thymocyte surface molecules may serve as a biomarker for toxicity involving apoptosis. (Supported in part by grants from the NSF/EPA and NIH)

EFFECTS OF TYPICAL AND ATYPICAL ANTIPSYCHOTICS ON PCP-DISRUPTED PREPULSE INHIBITION IN RATS. Kendra Kennedy, Dept. of Psychology, & Jenny L. Wiley, Dept. of Pharmacology & Toxicology, Virginia Commonwealth University, Richmond, VA 23298. A decrease in the magnitude of a startle reflex is observed when rats are exposed to a low intensity acoustic stimulus a few milliseconds prior to the sudden high intensity stimulus that elicited the initial startle response. This innate ability, prepulse inhibition (PPI), is disrupted by NMDA antagonists [phencyclidine (PCP), dizocilpine], and some dopamine agonists (amphetamine, apomorphine). Disrupted PPI is an animal model of the deficits in sensorimotor gating present in some schizophrenics. In rats, some atypical antipsychotic drugs (APDs) (clozapine, risperidone, olanzapine), but not the typical APD (haloperidol), have been shown to partially restore PCP-disrupted PPI. However, haloperidol has a selective binding property, and is the only typical APD tested in this paradigm. Therefore, typical APDs with more diverse binding profiles (and some atypicals) were tested for their effects on PCP-disrupted PPI. Rats were pretreated with clozapine, chlorpromazine, loxapine and thioridazine alone, and in combination with PCP. Disruption of PPI was observed with PCP 3mg/kg. Clozapine and thioridazine dose dependently reduced startle magnitude, while demonstrating a trend towards restoring disrupted PPI. Chlorpromazine and loxapine did not decrease startle and had no effect on disrupted PPI. These data suggest that atypical APDs exert their influence by their depressive qualities, and support the hypothesis that this model may be useful in identifying novel compounds with atypical properties. (Supported by NIDA grant DA-01442.)

PERFORMANCE OF A DELAYED NONMATCH TO POSITION TASK IS IMPAIRED BY CHOLINERGIC AND GLUTAMATERGIC MODULATORS K. LaVecchia, Catherine Willmore\*, Patrick M. Beardsley\*, and Jenny L. Wiley Virginia Commonwealth University, Medical Campus, Richmond, VA The delayed-nonmatch-to position (DNMP) operant procedure is frequently used to model cognition because it affords a separation between experimental effects entailing attention, mnemonic encoding, or retention across temporal delays. A broad literature supports the involvement of N-Methyl-D-Aspartate (NMDA) receptors in both attention and memory processes. The present study was undertaken to assess mnemonic effects produced by NMDA antagonists in rats responding under a food reinforced DNMP operant procedure. Scopolamine (SCOP), an antimuscarinic compound well known for its amnesic effects, was first tested as a positive control. The noncompetitive NMDA receptor antagonist phencyclidine (PCP; 0.5mg/kg-8mg/kg) and D CPPene (0.1mg/kg-1.7mg/kg), a competitive modulator, were then analyzed. While tests with D CPPene did not reveal performance deficits in these well trained animals, several doses of Scopolamine and PCP produced impairment. Specifically, these treatments produced impairments which manifested as a decrease in overall accuracy. Deficits created by SCOP and PCP were shown to be dose dependent, but only when examined across brief delay intervals. These data suggest an effect for SCOP and PCP in modulating attention, or the encoding of new information, but not its retention. Supported by NIDA grants DA-01442 and DA-07027.

REVERSING  $\Delta^9$ -TETRAHYDROCANNABINOL ANTINOCICEPTIVE TOLERANCE BY BLOCKING PHOSPHORYLATION OF THE CB1 RECEPTOR. Matthew C. Lee, David Stevens, Sandra Welch, Dept. of Pharmacology, and Toxicology, Medical Col. of Va. Campus, Va. Commonwealth Univ., Richmond, Va. 23298. Phosphorylation alters tolerance to cannabinoids. It is proposed that phosphorylation enhances the down regulation of the CB1 receptor. We hypothesize by preventing any additional phosphorylation of the receptor we may reverse tolerance. We tested the role of several kinases in tolerance including protein kinase A (PKA), protein kinase C (PKC), and protein kinase G (PKG). We evaluated PKA using KT5720 a PKA inhibitor; PKC using bisindolylmaleimide I, HCl, a PKC inhibitor; and PKG using KT5823, a PKG inhibitor. ICR mice were rendered tolerant to  $\Delta^9$ -Tetrahydrocannabinol (THC) by injections every 12 hours of 20mg/kg THC for 6 days and only the morning dose was given on day 7. The mice were subsequently challenged 24 hours following the day 7 dose with an ED80 of 20 $\mu$ g/5 $\mu$ L THC intrathecal. The PKG inhibitor was shown to be inactive. No effect was seen on THC tolerant vs. Non tolerant groups as measured by the tail flick test. The PKC inhibitor was active in that it attenuated the antinociceptive effect of THC in non-tolerant mice (reduced %MPE from 74.4 to 4,  $p < 0.05$ ). The PKC inhibitor also non-significantly reduced %MPE in tolerant mice from 35.5 to 3.3. The PKA inhibitor in non-tolerant mice attenuated the effects of THC; the %MPE was shifted from 74.3 to 28.5 ( $p < 0.05$ ), respectively. However in tolerant mice %MPE was non-significantly increased from 35.5 to 67. These data support a role for PKA in phosphorylation in tolerance, but also suggest an inhibitory role of PKA and PKC in acute effects of THC. (Supported by NIDA grants K02DA00186 and P50DA05274)



ROLE OF CARDIAC GLUTAMATE RECEPTOR SUBTYPES IN LIMITATION OF INFARCT SIZE IN ISCHEMIC PRECONDITIONING. Ahmed A. Mabrouk, Anwar S. Abdel-Fatah, and Shi Pin Goa, Depts. Of Surgery and Pharmacology and Toxicology, Va. Commonwealth Univ., Richmond, VA. 23284. Pervious studies have shown that low levels of calcium mobilization has been proven to partially protect the myocardium. Based on these studies, glutamate, an excitatory neurotransmitter which stimulates extracellular calcium influx and release intracellular stores. As a result, glutamate was used to try to precondition the myocardium. Sodium glutamate, 100µm (0.35ml) and AMPA, 0.25mg/Kg were used as agonists. DNQX (2.5mg/Kg), MK-801 (2.5mg/Kg) and MCPG (2.5mg/Kg) were used as antagonists. Adult male rats (180-200g) were ventilated and instrumented to monitor heart performance. After 30 min stabilization period, rats were intravenously injected with saline and used as the control. A protocol of 5 min coronary artery occlusion followed by a 10 min reperfusion was used as the preconditioning model. The remaining drugs were also administered intravenously and then followed by 30 min ischemia and 120 min reperfusion. The combining of agonists and antagonists in different orders was also used. The area at risk was comparable between all animals. The infarct size/area at risk (% Infarct) were as follows: control group= 56.6, PC group= 10.9, Glutamate group= 12.9, AMPA group = 12.75, DNQX group= 39.9, the MK-801 group= 56.9, MCPG group= 29.8. The result show that glutamate succeeded in protecting the myocardium against the increase in the infarct area. Glutamate receptor antagonists abolished cardioprotection induced by PC or agonists. Receptor occupation by agonists protects against antagonists and vice versa. Thus glutamate can be used to precondition the myocardium against further injury.

THE EFFECTS OF PRENATAL STRESS (PS) ON CONCENTRATIONS OF BRAIN/NEURONAL NITRIC OXIDE SYNTHASE (nNOS) IN THE PREOPTIC AREA (POA) OF MALE RATS. Miller, S. D., Mueller, E.\*, Gifford, G., & Kinsley, C. H. Dept. of Psych., Univ. of Richmond, VA. PS demasculinizes and feminizes male sexual behavior (Ward, 1972). Further, PS males display lower luteinizing hormone release and less c-fos activation in response to sexually receptive females (Humm et al., 1995; Kinsley et al., 1992) The role of nNOS in the expression of male sexual behavior is becoming clear: Too little, or blockade of its synthesis, and sexual behavior is disrupted (Benelli et al., 1995; Bialy et al., 1996). Thus, the PS paradigm, characterized by exposing late-pregnant rats (GD 14-21) to thrice-daily heat and restraint stress, was utilized to examine adult concentrations of nNOS in the rat mPOA, a brain region that regulates male sexual behavior. Brains were obtained from PS and non-PS males and processed for nNOS ICC. Image analysis was performed to visualize and count nNOS immunoreactive (IR) neurons. PS rats had less nNOS-IR in mPOA compared to controls. Thus, PS may disrupt sexual behavior, in part, through depletion of, and/or effects on, nNOS neurons in mPOA. (Supp. By NSF & U. Richmond. Research funds.)

AN ANALYSIS OF PROTECTION AGAINST A 4T1 CHALLENGE PROVIDED BY AN INACTIVATED IL-2 TRANSFECTED 4T1 TUMOR VACCINE PHARMACOLOGICALLY ACTIVATED BY BRYOSTATIN 1 AND IL-2. Abhilash Nambiar, Dept. of Biology, Va. Commonwealth Univ., Richmond, VA 23284, & Harry D. Bear\*, Depts. of Surgery and Microbiology and Immunology, Med. Col. of Va., Va. Commonwealth Univ., Richmond, VA 23298. Active immunization protocols may be an effective alternative to prevent metastasis or recurrence in the treatment of cancer as genetically engineered tumor cell vaccines have been successful at inducing immunity in naïve mice. Since the 4T1 cell line, a murine mammary cancer, is very weakly immunogenic and the interleukin-2 (IL-2) transfected vaccine (4T1/IL-2) is unlikely to provide sufficient protection, we also tested the ability of bryostatin 1 (bryo), an activator of protein kinase C, and IL-2, a potent inducer of lymphocyte proliferation, to augment the vaccine's ability to protect from an unmodified tumor cell challenge. On day 0, four of five groups received inactivated 4T1/IL-2 cells intradermally in the flank. Starting on day 3, each of the vaccinated groups received either no treatment or were intraperitoneally injected with either a single dose of 0.0125 µg bryo, 5000 IU IL-2 b.i.d. for 5 days, or both. On day 14, all groups were administered a challenge dose of the parental tumor and palpable tumor area was measured periodically. After the mice were sacrificed, pulmonary metastases were enumerated. In the first experiment, only the bryo-treated vaccine 10<sup>6</sup> cells provided protection against 2x10<sup>5</sup> challenge. Vaccine treatments were reduced to 2.5x10<sup>5</sup> and challenge dose to 2.5x10<sup>4</sup> cells. Only the bryo and IL-2 treated group showed a statistically significant slowing of tumor growth. The metastatic data showed that the vaccine groups treated with IL-2 alone or bryo + IL-2 showed significant reductions in nodules, although visual examination showed that all bryo amplified showed smaller nodules.

MIGRATION OF GAMMA-IRRADIATED PLASMID CONFORMERS IN DYNAMIC SIZE-SIEVING CAPILLARY ELECTROPHORESIS. Stacey A. Nevins<sup>1</sup>, Barbara A. Siles<sup>1\*</sup>, and Zeena E. Nackerdien<sup>2\*</sup>. <sup>1</sup>Dept. of Chem., Col. of William and Mary, Williamsburg, VA 23187. <sup>2</sup>Memorial Sloan Kettering Cancer Ctr., New York, NY 10021. Dynamic size-sieving capillary electrophoresis (CE) was used to detect radiation-induced fragmentation of plasmid conformers. Plasmid molecules, ranging in size from 2900 to 27,000 base pairs, were irradiated with a  $\gamma$ -<sup>60</sup>Co source at doses of 50-400 Gy. DNA fragments were separated in dilute hydroxyethylcellulose/ THE buffer solutions containing no intercalating dyes. Detection was by UV absorbance at 260 nm. Slab gel electrophoresis was used to confirm peak identities. CE with UV detection showed greater resolution of DNA fragments in comparison with slab gel separations.

MOLECULAR MODELING STUDIES OF 2-PIPERAZINYLBENZIMIDAZOLES AT 5-HT<sub>3</sub> SEROTONIN RECEPTORS. Thomas Prisinzano. Department of Medicinal Chemistry, School of Pharmacy, VCU; Richmond, VA 23298-0540. Serotonin (5-HT) receptors have a wide variety of physiological functions in the body. As a result at least 14 different subtypes have been found. The 5-HT<sub>3</sub> receptor is unique because unlike most 5-HT receptors it is a ligand-gated ion channel receptor. The 5-HT<sub>3</sub> receptor has been implicated in the control of nausea and emesis and is thought to play a role in schizophrenia and in migraine. 5-HT<sub>3</sub> receptor antagonists have been shown to be quite effective in the control of nausea associated with cancer chemotherapy. Recently a series of 2-piperazinylbenzimidazoles have been shown to be both selective and potent antagonists at 5-HT<sub>3</sub> receptors. These compounds appear lack some of the essential features of previous models. The previous models were reexamined in an effort to explain the activity of these compounds. It was supposed that a hydrogen bond acceptor site rather than a carbonyl oxygen is crucial for binding at 5-HT<sub>3</sub> receptors. A new 3D model was generated consisting of an aromatic ring, a hydrogen bond acceptor site, and a positive ligand to better explain activity at 5-HT<sub>3</sub> receptors.

EVIDENCE FOR THE INVOLVEMENT OF FAS LIGAND AND PERFORIN IN THE INDUCTION OF VASCULAR LEAK SYNDROME. Asimah Rafi-Janajreh\*, A. Zeytun, M. J. Bradley, D. Phillip Sponenberg, R. L. Grayson, M. Nagarkatti and P. S. Nagarkatti Dept. of Biol., Plant Pathology, Physiology and Weed Science, and Biomedical Sciences and Pathobiology, VA-MD Col. of Vet. Med. Endothelial cell injury resulting in vascular leak syndrome (VLS) is one of the most widely noted phenomena in a variety of clinical diseases. In the current study we used interleukin-2 (IL-2) induced VLS as a model to investigate the role of cytolytic lymphocytes in the cytotoxicity of endothelial cells. Administration of IL-2 (75,000 units/mouse three times a day for 3 days) into BL/6 wild-type mice triggered significant VLS in the lungs, liver and spleen. Interestingly, perforin-knockout (KO) mice exhibited marked decrease in IL-2 induced VLS in all three organs tested. Also, FasL-defective (*gld*) mice and Fas-deficient (*lpr*) mice exhibited decreased VLS in the liver and spleen, but not in the lungs. The CD44-ko mice displayed decreased VLS in the lung, liver and spleen. The decreased VLS seen in perforin-KO, *gld* and *lpr* mice was not due to any defect in lymphocyte migration or homing to various organs because histopathological studies in these mice demonstrated significant and often greater perivascular infiltration of lymphocytes when compared to the IL-2 treated wild-type mice. Ultrastructural studies of the lungs demonstrated significant damage to the endothelial cells in IL-2 administered wild-type mice, and decreased damage in perforin-KO mice. IL-2 administration caused upregulation of CD44 in all strains of mice tested and triggered increased LAK activity against an endothelial cell line in wild-type and *gld* mice, but not in perforin-KO mice. The current study demonstrates for the first time that perforin and FasL may actively participate in endothelial cell injury and induction of VLS in a variety of organs. (Supported by grants from ACS and NIH)

## LIGAND DESIGN AND SYNTHESIS BASED ON SEROTONIN RECEPTOR STRUCTURE.

S. Runyon, R. Glennon, R.B. Westkaemper, Dept. of Medicinal Chemistry, Va. Commonwealth Univ., Richmond VA. 23298-0540. G-protein coupled receptors (GPCR) are important targets for drug design. Unfortunately, very little direct experimental information is available regarding the precise three-dimensional structure of these membrane bound neurotransmitter receptors. Most information relevant to GPCR structure is inferred from three types of indirect investigations: theoretical receptor modeling studies, ligand structure-activity relationship studies (SAR), and receptor structure-activity relationship studies (site directed-mutagenesis). Each approach has ambiguities when employed in isolation. We have embarked on a program to elucidate 5-HT<sub>2A</sub> receptor features necessary for ligand affinity and receptor function that uses information from all three types of studies in a complementary fashion. These studies focus on the relationships between the standard agonist DOB, a novel series of tricyclic analogs of DOB (ligand SAR), and specific aromatic amino acid residues in the sixth transmembrane domain of the receptor (modeling, receptor SAR).

EFFECT OF 2,3,7,8- TETRACHLORODIBENZO-*p*-DIOXIN (TCDD) ON NAIVE AND INDUCED NATURAL KILLER CELL-MEDIATED CYTOTOXICITY. David Scanlan.

Mitzi Nagarkatti, and Prakash S. Nagarkatti. Depts. of Biology and Biomedical Sciences and Pathobiology, Virginia-Maryland College of Veterinary Medicine, Virginia Tech, Blacksburg, VA 24060. 2,3,7,8- tetrachlorodibenzo-*p*-dioxin (TCDD) is an environmental pollutant well known for its toxic effects on the immune system. However, the mechanism of immunotoxicity is unclear. Previous studies in our lab showed that mice injected i.p. with 1- 50 µg/kg of TCDD displayed thymic atrophy triggered by increased production of soluble Fas ligand (FasL). Inasmuch as Natural Killer (NK) cells express FasL and use this molecule to kill tumor targets, in the current study we investigated the effect of TCDD on NK cell function. It was hypothesized that TCDD upregulates FasL expression on NK cells and induces increased lysis of tumor cells. To this end, C57BL/6 female adult mice were injected with 50 µg/kg body weight of TCDD and 1-5 days later, naive NK cells from the spleen were tested for cytotoxicity against YAC-1 tumor targets. In addition, to study the activated NK cells, mice were injected with IL-2 or poly I:C. The control mice were injected with vehicle alone. The results demonstrated that TCDD did not alter the cytotoxicity mediated by naive NK cells, significantly. In contrast, TCDD-treatment caused enhanced cytotoxicity by activated NK cells. This was contradictory to the well-known immunotoxic effects of TCDD. We suggest that TCDD may upregulate the activated NK cell activity by inducing increased expression of FasL. (Supported in part by grants from NIH and EPA).

INSPECTING SEROTONIN RECEPTORS: A NEW TOOL FOR 5-HT<sub>2</sub> IMAGING STUDIES.

Cynthia Schieck, Kan Sam Lee\*, Richard A. Glennon. Dept. of Medicinal Chemistry, School of Pharmacy, Virginia Commonwealth University, Richmond, VA 23298-0540 and NIMH Neurosciences Center, Washington, D.C. Serotonin (5-HT) receptors are known to play an important role in a variety of disease states. One population of 5-HT receptors, 5-HT<sub>2</sub> receptors, is thought to be involved in depression, anxiety, and psychotic behavior, diseases of the CNS. These disorders are often difficult to diagnose and treat. Visualizing cellular proteins through imaging studies has become commonplace in diagnosing and monitoring diseases. Single-photon emission computed tomography (SPECT) imaging allows particular receptors to be studied with distinct advantages over other imaging methods. These studies require selective ligands for the receptor protein of interest and conversion of the ligand into a radiolabeled imaging tool. No such ligand has been useful for the selective imaging of 5-HT<sub>2</sub> receptors. 1-(2,5-Dimethoxy-4-iodophenyl)-2-aminopropane (DOI) has high affinity and selectivity for 5-HT<sub>2</sub> receptors. Treatment of DOI with hexamethylditin gave 4-trimethylstannyl-des-iodo-DOI. The subsequent substitution reaction of this intermediate with [<sup>123</sup>I]-Nal gave [<sup>123</sup>I]-DOI in ≈ 65% radiochemical yield. Intravenous SPECT studies using [<sup>123</sup>I]-DOI in non-human primates show that this material readily crosses the blood-brain barrier and binds selectively to 5-HT<sub>2</sub> receptors in the brain.

COMPARISON OF FILM-SCREEN MAMMOGRAPHY WITH DIGITAL SPOT MAMMOGRAPHY IN THE EVALUATION OF BREAST MASSES AND CALCIFICATIONS. Tiffany S. Sedgwick and Dr. Ellen Shaw de Paredes\*, Dept. of Radiology, Va. Commonwealth Univ., Med. Col. of Va., Richmond, Va. 23298. Digital acquisition and display of mammographic images have the potential for radiologists to make improved evaluations of suspect abnormalities present in routine mammographic screening. The efficiency of a digital mammographic unit was evaluated in a clinical setting which tested radiologists' confidence in diagnosing patients by viewing analog versus digital breast images. Radiologists were not as confident calling true benign lesions benign when using the digital system versus the analog system, but had similar confidence when diagnosing true malignant lesions as malignant when viewing the analog and digital images. Difference in radiologists' confidence in the analog and digital system was most likely due to unfamiliarity with the digital system and adjustment to improved lesion detectability. Imaging capabilities present in a digital system versus those used in analog imaging system were also evaluated using a contrast-detail phantom. Evaluation of the contrast-detail phantom demonstrated that object visibility was related to dose. The digital system produced greater object visibility than the analog system, and alternate target-filter combinations can provide better visibility with reduced dose for certain types of breasts, particularly those that are more dense or thick. The optimal techniques for imaging various breast types when using a digital system will be implemented in the clinical setting.

#### COMPARISON OF PHARMACOLOGICAL PROFILES OF NICOTINE AND ISONICOTINE.

J. E. Slemmer, W. S. Glassco, B. R. Martin, & M. I. Damaj, Dept. of Pharmacology and Toxicology, Medical College of VA. Campus of VA. Commonwealth Univ., Richmond, VA. 23298. A series of N-substituted and 6-substituted ( $\pm$ ) isonicotine analogs were synthesized and tested in vivo and in vitro for nicotine-like activity. ( $\pm$ ) Isonicotine had a lower binding affinity in vitro and lower potency in vivo (analgesia, spontaneous activity) than nicotine; the effect of ( $\pm$ ) isonicotine in vivo was stereoactive with the (-) isomer being more potent. ( $\pm$ ) Norisonicotine had a higher affinity than isonicotine, and with partial agonistic effects in vivo. N-Substituted derivatives of norisonicotine, ( $\pm$ ) N-propyl and ( $\pm$ ) N-cyanoethyl, were found to be less active than norisonicotine, possibly due to the long length of their nitrogen substituents. 6-Chloronorisonicotine was found to be a full agonist in vivo and had a higher affinity than norisonicotine. 6-Methoxynorisonicotine, another 6-substituted derivative, was found to be less active than norisonicotine. The tendency of the 6-substituted derivatives to be more active than the N-substitutes was also found in epibatidine and nicotine analogs. In addition, two oxygen-linked derivatives of norisonicotine did not have higher binding affinities than their parent analog. The comparisons between nicotines and isonicotines indicated similarities and dissimilarities within both groups showing a disconnection between binding affinity and in vivo activity as the nitrogen substituent was varied. Supported by NIDA grant DA-05274.

CORNEAL WOUND HEALING IN A DIABETIC RABBIT MODEL: EFFECTS OF AMINOCAPROIC ACID ON RE-EPITHELIALIZATION. Marci Smith. Dept. of Biol., Old Dominion Univ., Norfolk, VA 23529, & Patricia B. Williams. Dept. of Physiol., Biochem., & Pharm., Eastern Va. Med. Sch., Norfolk, VA 23507. Diabetic patients have excessive activated plasmin, which interferes with cell adhesion. By inhibiting plasmin aminocaproic acid, ACA, could promote wound healing to improve epithelial attachment. The purpose of this study is to determine if scanning electron microscopy (SEM) can be used to quantitatively evaluate pathologic conditions, such as diabetes, and after drug application, such as ACA. SEM photos were digitally scanned and analyzed using image analysis software. The parameters measured were cell area, cell perimeter, and number of cell sides. Cell area and cell perimeter detected significant differences between euglycemic and hyperglycemic rabbits and also detected the effect of ACA. Number of cell sides was not a useful measurement. Therefore, quantitative analysis of SEM is a suitable model for demonstrating pathologic changes and drug effects.

EXPRESSION OF TISSUE INHIBITORS OF METALLOPROTEINASES IN 2-D AND 3-D CULTURES. Tricia T. Tran & D. Yager\*. Plastic Surgery Research Lab. of Dept. of Surgery, Va. Commonwealth Univ., Richmond, Va. 23298. The organization of extracellular matrix (ECM) is an important function in many biological and pathophysiological processes. A three-dimensional collagen lattice can produce skin fibroblasts with a cell culture environment that simulates normal dermis. The aim of this experiment was to study the influence of the ECM environment on the expression of Tissue Inhibitors of Metalloproteinases-1 and -2 (TIMP-1 & TIMP-2) in monolayer and three-dimensional cultures. Their TIMPs and mRNAs activities were quantitated by using the Enzyme Linked Immunosorbant Assay and the Ribonuclease Protection Assay. Our data showed that the level of TIMP-2 production and their mRNA were relatively insignificant in both system models. However, the TIMP-1 and their mRNA activities were elevated significantly in the monolayer system in comparison to the 3-D system. This difference was probably the result of better RNA translation in the 2-D system model, some low affinity of TIMP-1 proteins to the collagen matrix, and/or more degradation in the 3-D system model.

ACUTE EFFECTS, TOLERANCE AND DEPENDENCE WITH COMPOUNDS WITH CANNABINOID ACTIVITY IN MICE. T.L. Troy, G.A. Patrick and B.R. Martin. Sch. of Pharmacy and Dept. of Pharmacology and Toxicology, Med. Col. of Va. of Va. Commonwealth Univ., Richmond, Va 23298. The acute effects of anandamide (ANA), the purported endogenous ligand at cannabinoid receptors, methylfluoroanandamide (FA), a synthetic analog, and WIN 55,212 (WIN), a synthetic analog of  $\Delta 9$  tetrahydrocannabinol (THC), on nociception and on spontaneous locomotor activity (SLA) were characterized. The development of tolerance and dependence with cannabinoids using techniques of either sustained-release pellet implantation or repeated s.c. injections was investigated. The acute effects of sustained-release THC pellets on SLA was studied. The antinociceptive effect of cannabinoids was determined by use of the tail-flick response to a thermal stimulus. SLA was determined by measurement of interruption of infrared beams using an Omnitech activity monitor. Dependence was assessed by counting withdrawal signs precipitated by injection of the cannabinoid antagonist SR141716A (SR). Acute s.c. injection of ANA, FA and WIN all produced cannabinoid-like effects on nociception and SLA. WIN was the most potent and exhibited the longest duration of action. WIN administered by repeated s.c. injections (two injections per day for three days) produced significant tolerance to its effects on nociception and SLA. Withdrawal also occurred following administration of SR to the mice given WIN repeatedly. S.C implantation of pellets containing THC led to suppression of SLA 2-24 hours after implantation. Physical dependence was evident 3-5 days after implantation, as indicated by observation of withdrawal signs after injection of SR. ANA, FA and WIN are all cannabinoid-like in their acute effects. WIN is capable of producing THC-like tolerance and dependence. Dependence upon THC itself can be produced by s.c. implantation of a sustained-release pellet.

CELL DEATH FOLLOWING STRETCH-INDUCED INJURY. John T. Weber, Karen A. Willoughby, Beverly A. Rzigalinski, and Earl F. Ellis. Dept. of Pharmacology and Toxicology, Medical College of Virginia, Virginia Commonwealth University, Richmond, VA 23298-0613. Our laboratory has developed an *in vitro* model of stretch-induced injury (Ellis et al., J. Neurotrauma 12:325, 1995) that produces many of the post-traumatic responses seen in *in vivo* traumatic brain injury (TBI). We have assessed cell injury with our model by measuring uptake of the dye propidium iodide (PrI) which is normally excluded from intact cells. We have shown that PrI uptake increases with the severity of injury in cultured astrocytes and that PrI uptake decreases with time post-injury, indicating an ability to repair. Unlike astrocytes, pure neuronal cultures show little uptake of PrI immediately after injury. However, PrI uptake increases with time after injury indicating that neurons may undergo a delayed cell injury and possible delayed death. Using Fura-2 microspectrophotometry we found that intracellular free calcium ( $[Ca^{2+}]_i$ ) levels increase immediately after injury in astrocytes and neurons. By 24 hrs post-injury  $[Ca^{2+}]_i$  returns to basal levels in astrocytes, while  $[Ca^{2+}]_i$  in severely injured neurons is still elevated at 24 and 48 hr post-injury suggesting calcium homeostasis is disrupted and membrane integrity may be compromised. Using the Annexin V apoptosis detection method we found positive staining astrocytes, and to a larger extent neurons, at 24 and 48 hr post-injury. These results suggest that neurons may be more susceptible to stretch-injury than astrocytes and that both apoptotic and necrotic cell death may occur in TBI. Supported by NS 27214.

IMMUNOTOXICITY INDUCED BY TUMOR SECRETED FAS LIGAND. Ahmet Zeytin Mitzi Nagarkatti, and Prakash S. Nagarkatti. Department of Biology, Biomedical Sciences and Pathobiology, Virginia-Maryland College of Veterinary Medicine, Virginia Tech, Blacksburg, VA. There are two major pathways used by Cytotoxic T Lymphocytes (CTLs) to lyse target cells: Fas ligand and Perforin. CTLs express Fas ligand upon activation and induce cytotoxicity of target cells expressing Fas. Recently we demonstrated that LSA, a T cell lymphoma, expresses high level of Fas ligand and can kill Fas<sup>+</sup> CTL specific to the tumor. In addition, LSA and EL-4 tumors expressed FasL induced apoptosis in Fas<sup>+</sup> target cells. In this study, we further investigated the role of the soluble form of the Fas ligand in tumor bearing host. We found that supernatant from FasL<sup>+</sup> EL-4 and LSA tumor contained higher level of the soluble Fas ligand, compared to the supernatant from FasL P815 tumor. Furthermore, sera from LSA and EL-4 tumor-bearing mice had significantly higher levels of soluble Fas ligand when compared to the control mice. Interestingly, the same sera induced apoptosis in thymocytes from C57BL/6 mice(Fas<sup>+</sup>), but not lpr (Fas<sup>-</sup>) mice. Also, liver, thymus, lung, and heart from EL-4 and LSA bearing C57BL/6 mice(Fas<sup>+</sup>), had more damage when compared to the tissues from EL-4 and LSA bearing C57BL/6 lpr/lpr mice (Fas<sup>-</sup>). Together our studies demonstrate that FasL-bearing tumor cells not only kill the tumor specific CTL but also cause significant damage and toxicity in organs that constitutively express Fas. (Supported by grants from ACS, NIH, and Sigma Xi).

## Microbiology and Molecular Biology

BIOCHEMICAL CHARACTERIZATION OF THE GUANINE-7-METHYLTRANSFERASE. Todd D. Prickett, Ravi Tayal, Jennifer De La Cour, and Thomas O. Sitz, Dept. of Biochemistry, Virginia Tech, Blacksburg, VA 24061. The methylation of the 7-position in the guanine base in the cap structure found at the 5'-end of eucaryotic mRNAs is essential for ribosome binding and translation. The guanine-7-methyltransferase (GMT), that methylates this site, was found to require thiol compounds in order to keep the enzyme reduced and maintain enzyme activity. Does this enzyme have reduced cysteine residues that are required for activity? When the GMT was reacted with *n*-ethylmaleimide (NEM) in Tris buffer at pH 8, inactivation occurred. In MOPS buffer (morpholinopropanesulfonic acid) at pH 7, no reaction with NEM was observed. The MOPS was blocking the cysteine residues from reacting with NEM. However, the enzyme was inactivated with NEM in phosphate buffer at pH 7. To further verify that essential cysteines were being modified, we incubated the enzyme with *p*-hydroxymercuribenzoate and found complete inhibition. This inhibition was reversed with excess thiol compounds. Therefore, we have shown that the guanine-7-methyltransferase has one or more reduced cysteine residues that are essential for catalytic activity.

ARE PLAY PITS A POTENTIAL HEALTH RISK? Kim Robertson (1), Susan Tipton, (1), Sandra G. Davis (2), Pamela Kiefer (2), Catherine Grano (2), Amy Corbett (2), Virginia McQuillen (2), Angela Wilson (2), and Mark Gray, Ph.D.(1); Department of B.C.E.S., and Department of Nursing, Christopher Newport University, Newport News, VA 23606. Soft Playground ball pits are popular recreation equipment located at fast food restaurants to entertain and occupy children during their meal. Hundreds of thousands of children jump, roll and play in them each year without major incident. However, the nature of the activity, the size of most facilities and the high level of use during peak hours necessarily increases the odds that a child in the early asymptomatic stages of a disease, could transmit the disease to others by contact. In addition, the design of most ball pits that we have observed is inherently flawed due to the lack of installed drains. This is particularly a problem since the undrained area, may provide a fertile environment for the accumulation opportunistic normal microbial flora.

In a cooperative research effort that involved students from School of Nursing and the Department of BCES, 7 ball pits located within the Hampton Roads area of Virginia, were randomly observed, surveyed and sampled. Each six hour sampling period spanned the time of peak play pit use. Nursing students performed surveys to determine the number of children who frequented the pits, and conducted a follow-up survey of randomly selected individuals to determine their health status subsequent to visiting a play pit. BCES students processed bacterial sample swabs of various areas of the play pits to determine the size and species distribution of bacteria found within the play pit area. Though the results are very preliminary, there is evidence that suggests that there may be a direct correlation between the size of the bacterial population within a ball pit and the number of children who succumb to maladies, such as diarrhea, that may be bacterial in origin.

ISOLATION OF PHAGE-DERIVED ANTIBODIES FOR IMMUNOMODULATION OF FLAVONOID METABOLISM. Michael Santos, and Brenda Shirley\*. Dept. of Biol., Va. Tech. Blacksburg, VA 24061. In an effort to further characterize secondary metabolism in *Arabidopsis*, a collection of antibodies was generated against the first two enzymes of the flavonoid biosynthetic pathway using phage display technology. This method utilizes a library of M13 phage engineered to express individual antibodies as single chains (i.e. ScFVs) fused to the M13 pIII coat protein. Phage with ScFVs that bound to either the chalcone synthase (CHS) or chalcone isomerase (CHI) antigen as revealed by ELISA assays were selectively propagated for analysis. Immunoblots loaded with *E. coli*-over-expressed thioredoxin-CHS or -CHI protein fusions show that most of the phage antibodies selected are specific to the antigens, having little or no cross-reactivity to contaminating *E. coli* proteins routinely detected by polyclonal anti-CHS or anti-CHI antibodies. We are now amplifying the genes encoding the SCFVs using modified versions of published primer sequences for subsequent cloning into plant transformation vectors. ScFV genes will then be mobilized into *Arabidopsis* where constitutive expression is expected to result in the immuno-modulation of CHS or CHI activity. Disruption of either of these enzymes' activities, as indicated by altered seed color, will confirm the feasibility of this antibody-based approach to altering metabolism. Furthermore, this approach may provide vital *in planta* evidence in support of our *in vitro* findings that protein-protein interactions occur among several enzymes of the flavonoid biosynthetic pathway.

IMMUNOLocalIZATION OF TWO FLAVONOID ENZYMES IN ARABIDOPSIS. David Saslowsky and Brenda Shirley\*. Dept. of Biol., Va. Tech. Blacksburg, VA 24061. The enzymes of certain metabolic pathways, such as glycolysis and the citric acid cycle, have been shown to function as multicatalytic complexes, or metabolons. Such organization offers a number of potential advantages with respect to metabolic efficiency, kinetics, and regulation. These include direct transfer (channeling) of intermediates between the reaction centers of enzymes without diffusion into the cytoplasm, protection of labile intermediates, and coordination of reactions of different metabolic pathways. The research interest of our laboratory is to determine if the enzymes of the flavonoid biosynthetic pathway exist as a cytosolic enzyme complex, and how such organization impacts metabolic regulation. Flavonoids are important secondary metabolites in plants that impart various characteristics such as pigmentation and protection from ultraviolet-B (UV-B) radiation, and are also important in human health as anti-oxidants and anti-cancer agents. Understanding the interactions and dynamics of flavonoid enzymes, or metabolic enzymes in general, is essential for engineering metabolism for agronomic improvement and bioproduction. Immunolocalization of the first and second flavonoid enzymes, chalcone synthase (CHS) and chalcone isomerase (CHI), respectively, is being used to determine if a flavonoid metabolon exists in *Arabidopsis*. A variety of *in vitro* studies in our laboratory including affinity chromatography, immunoprecipitation, and two-hybrid analysis have shown CHS and CHI to interact (Burbulis and Shirley, unpublished data). In wild type (Columbia) seedling sections, CHS and CHI demonstrate overlapping localization around vacuoles and at the cell wall. Localization near vacuoles is logical since the anthocyanin end products are transported exclusively into this organelle. Control sections, including tissue from CHS and CHI null mutants, failed to exhibit the labeling observed in wild type samples. In addition, several flavonoid mutants are being analyzed to determine if the mutation or absence of certain pathway enzymes affects CHS and CHI localization.

## Natural History & Biodiversity

TERRESTRIAL INVERTEBRATES OF THE HISTORICAL GREAT DISMAL SWAMP: PRELIMINARY RESULTS. Barbara J. Abraham, Dept. of Biological Sciences, Hampton Univ., Hampton, VA 23668, Sandra Y. Erdle, Va. Dept. of Conservation & Recreation., Div. of Natural Heritage, Richmond, VA 23219 & John F. Pagels, Dept. of Biology, Va. Commonwealth Univ., Richmond, VA 23284. Twenty-four sites in the Cities of Virginia Beach and Chesapeake were sampled by means of pitfall traps from June 1990 to November 1991 to delineate the ranges of *Sorex longirostris* subspecies in the historical Great Dismal Swamp outside the boundaries of the Great Dismal Swamp National Wildlife Refuge (Erdle and Pagels 1995). Sampled habitats ranged from grassy old fields to forests of various ages and types. Invertebrates collected during that study were the basis for the present study. Preliminary results comprised 42 collections from 15 of the 24 sites (approximately 1/3 of the data). A total of 5688 specimens included: 5616 arthropods, 51 earthworms, 2 leeches, and 19 snails. Arthropods included 820 arachnids (70 mites, 503 spiders, 243 harvestmen, and 4 pseudoscorpions), 6 centipedes, 1098 millipedes, 272 malacostracans (17 amphipods, 52 crayfish, one fiddler crab, and 203 pillbugs), and 3420 insects (15 orders). Aquatic and terrestrial animals occurred together in many samples. The large number of sites, samples, and specimens will make this completed study an important inventory of epigeal invertebrates of the historical Great Dismal Swamp.

GLYCEROL TOXICITY OF ELD'S DEER SPERMATOZOA IN PREPARATION FOR CRYOPRESERVATION. Adrienne Brown<sup>1</sup>, Steve Monfort<sup>2\*</sup>, Mitchell Bush<sup>2\*</sup>, Rebecca Spindler<sup>2\*</sup>, David Wildt<sup>2\*</sup>, Thomas Wood<sup>1,2\*</sup>. <sup>1</sup>New Century College, George Mason University. <sup>2</sup>Dept. of Reproductive Physiology, Smithsonian Institute Research and Conservation Center, Front Royal, VA, 22630. Eld's deer, *Cervus eldi thamin*, are a candidate species for assisted reproductive strategies involving spermatozoa cryopreservation. One problem associated with cryopreservation is cell injury caused by intracellular ice formation. In this study, semen was collected from two Eld's deer to study the potential toxic effects of glycerol, a cryoprotectant, on spermatozoa. Raw semen was placed in hepes-buffered Minimum Essential Medium (MEM), supplemented with 10% fetal calf serum and 0, 2, 4, 6, 8, 10 or 12% glycerol. Samples were maintained at room temperature in air (22° C) and observed for progressive motility and status over time (0-18 h). Spermatozoa viability was measured using a Sperm Motility Index (SMI). There was no evidence of immediate toxicity at any level of glycerol used in this study. Glycerol levels higher than those normally used in cell cryopreservation protocols (>4%) resulted in lower SMI values over extended periods of time (>4 h). These data suggest glycerol is an appropriate cryoprotectant for use in Eld's deer semen freezing trials.

VIRGINIA'S NATURAL AREA PRESERVES: DIVERSE SITES AND UNIQUE OPPORTUNITIES FOR RESEARCH. Sandra Y. Erdle and Richard K. Myers, Virginia Department of Conservation and Recreation, Division of Natural Heritage, 217 Governor Street, 3rd Floor, Richmond, VA 23219. Web address: <<http://www.state.va.us/~dcr/vaher.html>> Virginia's Natural Area Preserve System currently includes 23 dedicated natural areas. Natural Area Preserves (NAP) in Virginia are established with the primary objective of preserving natural heritage resources. Secondary objectives include scientific research and environmental education. Virginia NAP range in size from 29 to 2,577 acres and are managed with the objectives of restoring and protecting natural heritage resources using means such as prescribed fire, control of invasive species, and seasonal closure to the public. Habitats including coastal beach and dune systems, mature loblolly pine sandhills, sinkhole ponds, pocosins, limestone glades, magnesium-rich seeps, and exemplary shale barrens are protected in the NAP System. Research is urgently needed on many of these diverse preserves, indeed, persistence of many species and communities may depend upon new information which will guide ecological management efforts. Researchers who focus efforts on NAP can expect to obtain technical and field assistance and site histories from Division of Natural Heritage (DNH). In some cases, assistance with obtaining research funds may also be provided. DNH encourages outside researchers to focus on NAP. There remains much to discover about population biology of rare species, ecological processes and ecosystem dynamics. New efforts will contribute tremendously to current and future conservation and ecological management to perpetuate natural heritage resources.



COLD SHOCK PARAMETERS OF ELD'S DEER SPERMATOZOA COLLECTED BY ELECTROEJACULATION. Anthony Garcia<sup>1</sup>, Steven Monfort<sup>2</sup>, Rebecca Spindler<sup>2</sup>, David Wildt<sup>2</sup>, and Thomas Wood<sup>2,3</sup>. <sup>1</sup>Department of Biology, George Mason University. <sup>2</sup>Department of Reproductive Physiology, Smithsonian Institution Conservation and Research Center. <sup>3</sup>New Century College, George Mason University. Eld's deer are an endangered subtropical species of Cervidae whose range is primarily in Myanmar. Although a few remain in the wild, captive populations have been established throughout the world. Because these deer are highly endangered and exist in diverse populations, they are an excellent candidate for assisted reproduction strategies, including semen cryopreservation. One problem associated with semen cryopreservation is cold shock, damage that occurs to cell membranes during cooling. In this study, semen collected from five mature stags during their breeding season was subjected to a standard cold shock procedure. Individual samples from each male (30 $\mu$ l each) were plunged into ice-slush using straw containers for 30 minutes. Corresponding control samples of semen were maintained in straw containers at room temperature. Treatments were then allowed to warm to room temperature in air. Samples were evaluated for acrosome integrity and progressive motility and status. Acrosome integrity was measured using FITC-conjugated PNA staining. Progressive motility and status are parameters used in a standard sperm motility index (SMI). Using the PNA assay, more (P<0.05) spermatozoa were non-viable following cold shock treatment after controls. [58.8% vs. 27.6%]. SMI values for the control sample were higher (P<0.01) than cold shock. This study demonstrates that Eld's deer spermatozoa are subject to cold shock and that this characteristic must be considered when designing semen cryopreservation trials.

ANT BIODIVERSITY IN A LONGLEAF PINE FOREST AT THE BLACKWATER ECOLOGICAL PRESERVE. Leah Hembree & Deborah Waller, Dept. Biol. Sci., Old Dominion University, Norfolk, VA 23529. The Blackwater Ecological Preserve in Zuni, Virginia, represents the northernmost limit of longleaf pine. Ants are important species in forest ecosystems through their interactions with the vegetation, soil and other animals. We examined the ant species diversity in different plant communities at the Preserve by using a variety of collection methods: baiting, searching, Berlese funnel samples and pitfall traps. To date, nineteen genera in five ant subfamilies have been identified. Ant diversity was highest in the longleaf pine ridge, longleaf pine savanna, and a mixed community habitat. Ant diversity was lowest in the black gum swamp and mixed longleaf pine ridge and black gum swamp habitats.

HOST FISH IDENTIFICATION AND ARTIFICIAL CULTURE OF TWO FEDERALLY ENDANGERED FRESHWATER MUSSELS, THE FANSHELL PEARLYMUSSEL *Cyprogenia stegaria*, AND THE BIRDWING PEARLYMUSSEL *Lemiox rimosus*. Jess W. Jones and Richard J. Neves, Virginia Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061. Fish hosts were identified for two unionid mussel species, *C. stegaria* and *L. rimosus*. Fish hosts for *C. stegaria* were banded sculpin *Cottus caroliniae*, mottled sculpin *Cottus bairdi*, greenside darter *Etheostoma blennioides*, snubnose darter *Etheostoma simotermum*, banded darter *Etheostoma zonale*, tangerine darter *Percina aurantiaca*, blotchside logperch *Percina burtoni* and roanoke darter *Percina roanoka*. Confirmed fish hosts for *L. rimosus* were *Etheostoma blennioides* and *Etheostoma zonale*. Juvenile mussels of both species were successfully cultured for 30 days in free standing dishes containing high density algae (>2 x 10<sup>10</sup> cells/mL) and a thin layer of sediment (<1 mm).

COMPETITION BETWEEN TWO SYMPATRIC TERMITE CONGENERS (ISOPTERA: RHINOTERMITIDAE: *RETICULITERMES*) John Mathew & Deborah Waller, Dept. Biol. Sci., Old Dominion University, Norfolk, VA 23529. We examined the effect of soil disturbance and presence of competitors on two species of subterranean termites, *Reticulitermes flavipes* and *R. virginicus*. In the first experiment, termites preferred to enter undisturbed soil over soil that had previously been occupied by nestmates. In the second experiment, termites again preferred to enter undisturbed soil over soil that had previously been occupied by either nestmates or by members of the the other species. In the third experiment, separate units containing *R. flavipes* or *R. virginicus* but no food were catenated to a central unit with wood. In some trials, *R. flavipes* dominated the central units; in others, primarily *R. virginicus* occupied the central units.

HETEROGENERIC SPAWNING BETWEEN *CAMPOSTOMA A. ANOMALUM* AND *NOCOMIS L. LEPTOCEPHALUS* (ACTINOPTERYGII, CYPRINIDAE). Eugene G. Maurakis Science Museum of Virginia, Richmond, VA 23220 and Univ. Richmond, VA 23173, William S. Woolcott, Univ. of Richmond, VA 23173, and Mark H. Sabaj, Illinois Natural History Survey, Champaign, Illinois 61820. Analysis of videotapes indicated that a male *Campostoma a. anomalum* clasped individual female *Nocomis l. leptocephalus* in the spawning pit of a gravel nest of a male *N. l. leptocephalus*. Chronology of behaviors of male *C. anomalum* and female *N. leptocephalus* that resulted in three heterogeneric spawns were resolved into six sequential categories of activities: interim, approach, alignment, run, clasp, and dissociation. The heterogeneric clasp by the male *C. anomalum* is similar to that in male *Rhinichthys a. atratulus*, but unlike that of male *N. leptocephalus*. Supported in part by Richard and Carolyn T. Gwathmey Memorial Trust and University of Richmond Faculty Research Grants.

BREEDING BEHAVIORS IN *NOTROPIS ALBORUS* (ACTINOTERYGII: CYPRINIDAE). C Marie Newman, Longwood College, & Dr. Eugene Maurakis, Science Museum of Virginia, Richmond, VA., Dr. C. Michael Stinson, Longwood College. Breeding behaviors in *Notropis alborus* were identified through direct observation and videorecording in Mines Creek, VA., 18 March – 18 July, 1997. Behaviors were resolved into 3 categories: establishment of male territories, aggressive behaviors, and spawning behaviors. Individual male *N. alborus* established and defended their own territories after a period of combat when several males jockeyed for position over the substrate. Five forms of aggressive behavior (chase, parallel swim, non-contact head displacement and non-contact body displacement) were identified between breeding male *N. alborus*. Spawning occurred over sand and gravel, with a preferred substrate size of 6.0 and 11.3mm (based on Ivlov's index of electivity), at temperatures of 27-28° C. Six sequential categories of male and female interactions that led to spawning were identified in *N. alborus*: Interim (behavior of a male in his territory); Female Approach (behavior of a female toward an interim male); Male Approach; Alignment (orientation of male and female over substrate); Clasp (flexure of male's caudal peduncle over back of female), and Dissociation. Categories of spawning behavior in *N. alborus* also fit descriptions of spawning in *N. procyne*, by Raney (1947) and should provide an appropriate framework for describing spawning behaviors in other members of the *Notropis procyne* species group.

A SURVEY OF ECTOPARASITES IN ABANDONED SONGBIRD NESTS IN THE VIRGINIA ZOOLOGICAL PARK, NORFOLK, VA. Hannah Revis & John Neely, Dept. Biol. Sci., Old Dominion Univ., Norfolk, VA 23529.

Increased ectoparasitic loads have been shown to reduce the fitness of vertebrate hosts. This survey sought to identify ectoparasites and other invertebrates that inhabit songbird nests after the clutches leave. We collected eight abandoned nests located less than 9 m high from trees within the Virginia Zoological Park. Invertebrates were removed by first placing nests in modified Berlese funnels and then later dissecting the nests. Of the eleven different orders of macroinvertebrates identified, the Araneae, Collembola, Dermaptera, Diplura and Psocoptera were the most abundant. Two ectoparasitic Acari specimens were collected along with a common soil mite. Invertebrate eggs might have been missed.

DIFFERENTIAL USE OF PITCHER PLANT SPECIES AS NESTING SITES BY ISODONTIA WASPS. Philip Sheridan, Brian Hawley\*, and David Karowe\*. <sup>1</sup>Meadowview Biological Research Station, Woodford, VA. <sup>2</sup>Dept. of Biology, Western Michigan University. Isodontia are grass-carrying wasps which use hollow cavities to make straw nests to rear their young. We had observed that this wasp seemed to preferentially use slender-leaved pitcher plant species, such as Sarracenia rubra, as nesting sites over other pitcher plant species. We wanted to determine which species this wasp would choose if given a choice between S. alata, S. flava, S. leucophylla, S. minor, and S. rubra. Wasps strongly prefer S. minor and avoid S. alata. Overall wasps prefer smaller pitchers. However the fact that wasps prefer S. minor over S. rubra, despite similar pitcher sizes, suggests that factors other than pitcher size also play a role in nest selection.

INVERTEBRATE DATABASE MANAGEMENT SYSTEM FOR MILITARY AREAS. Kenneth J. Stein, Joseph Mitchell\*, and Jefferson L. Waldon\*, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. A method for rapidly assessing aquatic and terrestrial invertebrate communities was recently developed using a Geographic Information System (GIS). Insects and other invertebrates (>2,000) were collected from 36 vernal pools at Fort AP Hill in Caroline County, Va. All specimens were identified to genus and the resulting data entered into an ArcView® database. Our procedures resulted in the production of: 1) maps depicting the total insect and invertebrate fauna for each site, and 2) maps for each genus of insect. The ecological implications as well as land management applications are discussed.

A NEW LOCALITY FOR *ETHEOSTOMA FUSIFORME* ON THE COASTAL PLAIN OF VIRGINIA (PISCES: PERCIDAE). Werner Wieland, Dept. Of Biological Sciences, Mary Washington College, Fredericksburg, VA 22401. The swamp darter, *Etheostoma fusiforme*, is essentially a Coastal Plain species. It is found throughout the Coastal Plain ranging from main to Florida, west to Louisiana along the Gulf of Mexico and north into the lower Mississippi Valley as far as Illinois. The swamp darter is absent from the Rappahannock and York rivers. Its absence has previously been attributed to high sea levels caused by melting of continental glaciers that may have eliminated Coastal Plain populations of the Rappahannock, York, and Potomac (in Virginia) drainages. In 1997, while sampling in an unnamed tributary of the Poni River, a Coastal Plain stream in Caroline County, we obtained two specimens of the swamp darter. In addition, the following year we captured a specimen of the banded sunfish, *Enneacanthus obesus*, another absentee of the Rappahannock and York rivers, at the same locality. It is possible that both species occur in other streams of these drainages and we plan to sample these in the coming year.

## Psychology

### MARITAL DECISION MAKING SCALE: A PSYCHOMETRIC EVALUATION.

Kathy S. Babel, Dept. of Psychology, Old Dominion University, Norfolk, VA 23927, & William Fals-Stewart, Department of Psychology, Old Dominion University, Norfolk, VA 23927. The psychometric properties of the Marital Decision Making Scale (MDMS; Beach & Tesser, 1993) were evaluated in this investigation. Fifty-four couples served as participants. Distressed couples (n=27) were recruited from a community-based outreach clinic where they were seeking conjoint therapy for relationship problems, and nondistressed couples (n=27) were recruited from the community by ads placed in local newspapers. The MDMS and four other self-report relationship adjustment measures were administered to each partner in order to evaluate the psychometric properties of the inventory. Results indicated that the MDMS was a reliable and valid measure of marital decision making. (Supported by a grant from Alpha House Foundation)

### ENFORCEMENT, DEMOGRAPHICS, AND EDUCATIONAL INTERVENTIONS: A STUDY OF FACTORS ASSOCIATED WITH URBAN CHILD SAFETY SEAT USE.

Sara Marrese Bausch & Bryan E. Porter,\* Dept. of Psychology, Old Dominion Univ., Norfolk, VA 23529. This study examined the rate of child safety seat use observed in six Virginia cities during 1993, 1994, and 1996, independently and in relation to education and income of city residents. Analysis revealed an overall effect for city and year. Specific significant differences were found between two cities. Further, residents were most likely to use child safety seats in 1994. Child safety seat use was significantly correlated with high school education in 1993. Finally, community programs encouraging child safety seat use were examined via interviews with representatives from social services, maternity wards, and preschools in each city. No differences were found in these programs among cities. Overall findings suggested that differences in child safety seat use among the cities cannot be explained solely by education, income, or community programs. Enforcement data will be examined at a later date. Implications for these findings and directions for future research are discussed.

COGNITIVE ABILITY AND THE UNDERSTANDING OF SIMULTANEOUS EMOTIONS. Kelsay Berland, Stephanie Brewer, Emily Gipson, Amanda Robson, Alyssa Sellers, Nancy Margand. Dept. of Psychology, Washington & Lee University. Lexington, Va. 24450. Kindergarten, 1st grade and college subjects (rated as either conservers or non-conservers on Piagetian tasks) were asked to judge emotions in scenarios containing two, either similar or contradictory, emotion-inducing events. Both yes/no responses and judgments on a series of different sized hearts representing 'amount of love' felt in each scenario were required. Non-conservers were unable to affirm the presence of contradictory emotions on the verbal task. Judgments of heart size/amount of love were mainly determined by the last emotion presented in a pair. First grade conservers were capable of affirming the presence of simultaneous emotions but were also affected by the order of emotion inducing actions. Only college conservers were unaffected by the order of presentation of emotion-inducing activities and judged heart size by the overall amount of positive or negative behavior. They were also able to maintain a higher degree of felt-affection in the face of adverse actions. Results are interpreted in light of the inconsistent relationship between cognitive conservation skills and the ability to understand simultaneous emotions.

THE GENERATION EFFECT: PROBLEM TYPE AND STRATEGY USE. Tammy Bess, Danielle McNamara\*, Dept. of Psychology, Old Dominion University, Norfolk, VA 23529 and Alice Healy\*, Dept. of Psychology, University of Co., Boulder, CO 80309. This experiment investigated the generation effect for free recall of answers to arithmetic problems. A generation effect was found for both simple and difficult math problems, with both addition and multiplication. However, this experiment demonstrated a generation effect for answers to math problems only when the participants reinstated at test the cognitive procedures used at study. Participants who used the operand retrieval strategy, or using the problems to recall the answers, had a significant generation effect, while an effect was not found for participants using other strategies. Thus, this study provides further evidence of the procedural account of memory for the generation effect.

BEHAVIORAL AND ATTITUDINAL MEASURES OF STIGMA DUE TO PSEUDOLABELED DEVIANCIES: PRISON PAROLEE, SCHIZOPHRENIC, AIDS PATIENT, OR DIABETIC. Jonathan A. Bobst, Jennifer Gordon, V. Robin Joyce, Kristina N. Kirkland, Valentina Moore & James P. O'Brien, Tidewater Cmnty. Col., Virginia Beach, VA 23456. Five groups of adults (N=105; mean age=28.8 yr.) were told they could participate in survey research at their next class meeting, and one of 3 surveys would be administered individually by either a work-study student (control), a diabetes patient, a schizophrenia patient, an AIDS patient, or a prison parolee. Based on the substantial survey literature and two behavioral experiments by Kleck, it was anticipated that the more deviant the labeled target, the greater the behavioral and attitudinal rejection evidenced. In contrast, however, no significant differences were found for absence vs presence at the research class. Nor were there differences in choice of seat nearer or farther away from the target, time-on-task, or subject-initiated verbal behavior to the target. Nor did ANOVA indicate differences on attitudinal measures including the target's friendliness/courtesy, helpfulness, or need for the target's role. One attitudinal measure, willingness to participate as a randomly selected follow-up interviewee, yielded a significant Chi square, but differences did not appear intelligible. These participants in minimally interacting dyads are not as rejecting of these deviancy labels as the literature would lead us to believe. Future research might investigate whether minimally interacting dyads could reduce prejudicial attitudes.

THE NORMATIVE DISTRIBUTION OF MONOCYTES IN GOLDFISH OLFACTORY TISSUES. C. Bradshaw\*, M. Gilchrist, M. Gingerelli\*, E. Ginnis, T. Grandpre, L. Hall\*, B. Harris\*, R. Harris\*, A. Peterson\*, L. Salerno\*, & J. Stewart, Dept. of Psychology, Washington and Lee Univ., Lexington, Va. 24450. We are investigating the potential for macrophages and microglia to influence olfactory receptor neuron (ORN) turnover in goldfish (*Carassius auratus*). Immune system cells may modulate a variety of cellular processes, possibly including olfactory neurogenesis. Staining of cryosections with alpha naphthyl butyrate esterase (Sigma) which identifies macrophages in tissue sections, reveals labeled cells in sensory epithelium, olfactory nerve bundles within rosettes, and in the first nerve and olfactory nerve layer of olfactory bulbs. Less dense label is also seen in the granule cell regions of the bulb. This apparent concentration of macrophages among olfactory nerve fibers suggests an important role for these cells, and perhaps for their secretory products, in the removal and regrowth of ORN axons. We are currently mapping the normative regional distribution of phagocytic cells in these structures. We plan to compare this distribution with patterns of OX-42, ED-1, PCNA, and TUNEL immunostaining in rosettes and bulbs of goldfish. ORNs, with somata in the nasal cavity and axon terminals in the olfactory bulb, link the external environment with the central nervous system (CNS). (Support: W&L Glenn Grant program.)

EFFECTS OF OLFACTORY AND AUDITORY STIMULI ON COMPLICATED INFORMATION PROCESSING. Emily E. Cartwright, S. Wells\*, J. Leitch\*, T. Lorig, & D. Elmes, Dept. of Psych., Washington & Lee Univ., Lexington, VA. 24450. Previous studies have shown that reaction times and correct responses during spatial and verbal judgements are affected by odor presentation. Twenty-six undergraduates participated in this experiment which measured the effects of three odors (2% butanol, peppermint extract, Jovan Musk) and three sounds (bird call, cough, train) on performance of a spatial task, the Welsh Figure Preference Test (Revised Art Scale), and on a similar task involving words. Subjects judged whether or not they liked each stimulus by pressing "L" for like and "D" for dislike on a keyboard. Subjects were divided into a "healthy" group and a "hazardous" group. The healthy group was told that the odors were natural extracts and the hazardous group was told that the odors were chemical solvents. A low flow rate olfactometer delivered filtered room air and the three odors via teflon tubing to the subject's nostrils. A repeated measures ANOVA was performed for reaction times, correct responses, intensity ratings, and hedonic ratings. Subjects responded more slowly when peppermint and musk were presented regardless of whether they were answering correctly or incorrectly. Reaction times also revealed that males and females responded more quickly to words, and that subjects often responded incorrectly when they reacted quickly to these verbal stimuli. Subjects performed intensity ratings on the odors and sounds after each block of trials, and the ratings showed that over time subjects found these distractors to become more intense. It is necessary to continue research to determine the cognitive effects of odors. (Supported by NIH AREA Grant)

ASSUMPTIVE WORLDS, SEVERITY OF TRAUMATIC EVENTS, DEPRESSION, AND ANXIETY IN TRAUMA VICTIMS. Susan E. Cook & James E. Maddux, Department of Psychology, George Mason University, Fairfax, Va. 22003. Work with trauma victims has suggested that people generally hold a set of fundamental assumptions about the world and themselves that may be challenged by traumatic experiences. The purpose of this study was to examine: (a) how the fundamental assumptions, depression, and anxiety of trauma victims differ from non-victims; and (b) the relationship between severity of the traumatic event, belief in the assumptions, depression, and anxiety. Participants were 267 undergraduate psychology students from a state university. They completed questionnaires assessing their experience of traumatic events, perception of severity of the events, degree of belief in the fundamental assumptions, depression, and anxiety. Results indicated that crime victims perceived the world as having less meaning, being less just, and saw themselves as less worthy in comparison to non-victims. No differences were found on levels of either depression or anxiety between victims and non-victims. Within a large, heterogeneous victim group, all three assumption clusters (benevolence, meaning, and self-worth) significantly predicted depression. Benevolence and self-worth significantly predicted anxiety, with meaning showing a trend towards predicting anxiety. Neither objective nor subjective severity significantly predicted the assumptions, depression, or anxiety. Implications of these findings and suggestions for future research were discussed.

SHAME, GUILT AND SELF-EFFICACY FOR INTERPERSONAL PROBLEM-SOLVING. Michelle Vowell Covert, Nancy M. Heleno Obetz, James E. Maddux, and June Price Tangney, Dept of Psychology, George Mason University, Fairfax, VA, 22031. The relationship of shame-proneness and guilt-proneness to the ability to solve interpersonal problems, and to self-efficacy for implementing the solutions generated was examined. Results indicate that solution quality, self-efficacy for solving interpersonal problems, outcome expectancies and outcome value are negatively related to shame and positively related to guilt. Quantity of solutions generated was unrelated to both shame and guilt. In the course of this study, the scenario-based Measure of Interpersonal Problem-Solving (MIPS) was developed to assess this key aspect of emotional intelligence. Solution quality and quantity, self-efficacy for problem-solving, outcome value, and outcome expectancies for the self and others are measured by the MIPS. (Supported by the National Institute for Child Health and Human Development grants #R01 HD27171-06 and #R01 HD27171-06S1, and the Mark & Catherine Winkler Foundation.)

THE RELATIONSHIP BETWEEN PARENTING STYLE AND SOCIAL COMPETENCY IN PRESCHOOL CHILDREN Jennifer Detta and Jeffrey Pickens, Dept. of Psychology, James Madison University, Harrisonburg, VA 22807. This study examined the relationship between parenting style and preschoolers' social competency. Parenting style (Nurturance or Restrictiveness) was measured by having parents complete the Child Rearing Practices Report (Rickel and Biasatti, 1982). Measures of social competency included parent and teacher ratings of the 32 preschool children's social skills and problem behaviors using the Preschool/ Kindergarten Behavior Scale (Merrell, 1994). Results indicated that more Nurturant parents were less Restrictive. Children of parents who were more Nurturant were found to be significantly more socially competent. Children's social skills were inversely related to their problem behaviors. Parents tended to rate their children more positively than teachers on the social skills ratings. These findings have implications for researchers and clinicians interested in the influence of parenting styles on children's social development.

FEMINIST IDENTITY AND SELF-ESTEEM IN WOMEN IN FEMALE- AND MALE-DOMINATED COLLEGE MAJORS. Suzanne M. Endruschat & Barbara Winstead\*, Dept. of Psych., Old Dominion University, Norfolk, VA, 23529. Self-esteem and feminist identity were measured using the Rosenberg Self-Esteem Scale (Rosenberg, 1965) and the Feminist Identity Development Scale (FIDS; Bargad & Hyde, 1991) for 119 female undergraduate psychology, women's studies, and math/physical science students. A significant negative correlation was found between self-esteem and both the passive acceptance and revelation FIDS stages. Women in the FIDS revelation stage showed significantly lower self-esteem scores than women in all other FIDS stages. Women's studies students were not significantly different from women in other majors on the FIDS, nor did younger and older math/physical science students differ significantly from each other in their self-esteem and FIDS scores. The results, which were limited by small and unequal samples, suggested that college women of different majors were not different from each other in self-esteem and feminist identity.

PERSONALITY IMPLICATIONS OF STUDENT TRANSCRIPTS. Chet H. Fischer, Dept. of Psy., Radford Univ., Radford, Va. 24142. This study examined the question of whether students are able to regard academic transcripts as reflecting important personality characteristics of the creator of the transcript. One hundred and twenty male and female students were presented with one of six complete college transcripts and asked to rate the personality characteristics of the student who produced the transcript. The rated personality characteristics were derived from the "supertrait" research and rated on seven Likert continuums. The six transcripts contained the same courses but varied in terms of grades and I's and W's. It was hypothesized that the transcripts with the higher grades would be evaluated as reflecting more favorable personality characteristics than the transcripts with lower grades. This was confirmed. The transcript creating the greatest conflict was the A and B transcript with the I's and W's. It was clear that students do recognize that transcripts reflect important personality characteristics.

SERiation, ODDITY, AND COGNITIVE GAINS FOR DEPRIVED CHILDREN. Kim Garrett\* and Robert Parnak Dept. of Psych., George Mason University, Fairfax, VA 22030. Deficiencies in transitional classification and seriation abilities handicap some children when they enter kindergarten, and correlate with academic difficulties in grades K - 3. A learning set method was used to teach Head Start 4-year-olds the oddity concept and to insert items into a unidimensional series. In a game-playing format, children were help to solve 80 problems in which three items were similar while one differed in shape, size, orientation, or function. They also learned how to build series of 3 - 7 objects that differed in size, and to insert an object into its proper place in the series. When instruction concluded, the children were able to generalize their thinking abilities to new objects, and scored significantly better on questions from the Otis-Lennon School Ability Test.

EFFECTS OF KETOSIS ON ACTIVITY AND SPATIAL WORKING MEMORY IN THE RAT. M. J. Gilchrist, J. A. Boothby\*, C. J. Bradshaw\*, O. F. Russell\*, and L.E. Jarrard, Dept. of Psych., Washington & Lee Univ., Lexington, VA. 24450. Researchers have developed a ketogenic diet (KD) which induces ketosis and reduces seizure activity in epileptic children. A high fat and low carbohydrate regime, the KD causes the body to use fatty acids as the primary fuel source. Despite the scant research on the specific neurochemical and behavioral changes that ketosis produces, the KD's efficacy is unarguable. Behavioral effects of ketosis on humans are difficult to ascertain, however, given the confounding presence of anti-epileptic drugs and seizures which exist in most ketotic subjects. By inducing ketosis in rats, we hoped to identify direct behavioral effects of ketosis without these confounds. We hypothesized that the KD decreases neuronal activity as a means of inhibiting seizures and would therefore decrease both spatial working memory and motor activity in rats. Using a twelverm radial maze, spatial working memory was tested in both control and ketotic rats. After this testing, the control and ketotic rats were placed in an "activity-eating-drinking" (AED) device which measured the rats' motor activity every hour over 23 hour periods. Upon analysis of these data, we found that the KD had no apparent effect on spatial working memory, but significantly reduced motor activity. This decrease in motor activity might relate to the changes in GABA levels that have been previously reported in ketotic individuals. By further exploring the effects of ketosis, we might gain a clearer understanding of the biochemical processes underlying both seizures and seizure control.



CHANGES IN ACTIVITY, EATING, AND DRINKING FOLLOWING REMOVAL OF THE HIPPOCAMPUS IN RATS. Ginnis, E.J., Ellingson, T.W., Puzon, C.M., Jarrard, L.E., Dept. of Psychology, Washington and Lee Univ., Lexington, VA 24450. The effect of ibotenic acid and electrolytic hippocampal lesions vs. control rats were tested for eating, drinking, and overall activity levels. In Experiment 1 the data for these measures were collected in day/night light cycles over a 14-day postoperative period. Overall increases in all measures were found in the lesioned animals, with ibotenate lesioned rats exhibiting the greatest effect. The rats in Experiment 2 underwent 23-hour food deprivation periods over 12 days of testing. Activity levels during the 4 hours preceding the availability of food were recorded and compared across lesion groups. Lesioned groups exhibited significant increases in activity compared to controls, with the ibotenate lesioned animals exhibiting the highest levels of activity. Ibotenic lesioning resulted in an unexpected increase in drinking. In both experiments there were significant differences between conventional electrolytic lesions and ibotenate lesions in terms of the effects on activity, eating, and drinking.

UNILATERAL LESIONS OF THE HIPPOCAMPUS RESULT IN CIRCLING BEHAVIOR. Tadzia J. GrandPre' & Leonard E. Jarrard, Dept. of Neuroscience, Washington & Lee Univ., Lexington, Va. 24450. Rotational behavior, induced by unilateral lesions of a number of brain regions has long been studied as a model of various dopamine (DA) -related diseases. The hippocampal formation is interconnected with many of the brain's DA systems and is therefore potentially involved in modulation of DA-related diseases. The present study investigates unilateral hippocampal lesions, generated with either kainic acid (KA) and ibotenic acid (IBO), and subsequent rotational behavior. The results demonstrate that animals with unilateral KA hippocampal lesions exhibit significantly more rotation towards the side of the lesion immediately following surgery than either IBO lesioned animals or controls. Challenges with DA agonists at least 2 weeks post-surgery did not induce significant differences in rotational behavior. It appears that the former finding is a viable phenomenon which deserves further study.

PROCEDURALIZING ASPECTS OF TEAMWORK IN AN AVIATION DOMAIN. Jeffrey T. Hansberger, Robert W. Holt, Ph.D., Deborah A. Boehm-Davis, Ph.D., George Mason University. The long-term goal of transforming Crew Resource Management (CRM) from a set of attitudes to CRM-specific knowledge and skills is increasingly realistic. Knowledge of CRM is generally transferred through training in the classroom. Skills are usually trained in the flight simulator environment through Line-Oriented Flight Training (LOFT) and related sessions. This research is in the process of evaluating the effects of CRM procedures training in Line Check and Line Operation Evaluation (LOE) performance of flight crews. This study employs procedure-based CRM that integrates CRM training and requirements into the standard operating procedures of the air carrier. Traditionally, CRM training has been treated as a separate training issue, but in the current research, CRM is being closely integrated with technical procedures. One fleet in a regional air carrier received training under a carefully designed program called Advanced Crew Resource Management (ACRM). Initial results have given evidence for the effectiveness and advantage of ACRM training compared to traditional CRM training.

THE RELATIONSHIP OF ADULT ATTACHMENT, GENDER SCHEMA, AND DEPRESSION PRONE PERSONALITY STYLES. Kristie L. Hebert & Robin J. Lewis, Dept. of Psyc., Old Dominion Univ., Norfolk, VA 23529. The relationship among the depression prone personalities of autonomy and sociotropy, adult attachment style, and gender schema was explored. Eighty-five participants (80% women) completed the Personal Style Inventory-Revised (PSI-R), the Attachment Style Measure, the Self-Report Attachment Style Prototypes, the Adult Attachment Scale, and the Bem Sex Role Inventory (BSRI). Consistent with previous literature, an avoidant attachment style was associated with higher levels of autonomy and an anxious attachment style was related to higher levels of sociotropy. A secure attachment style was associated with lower sociotropic and autonomous concerns. Femininity was positively correlated with sociotropy, whereas masculinity was inversely related to sociotropy. Thus, an individual's adult attachment style and gender role appear to be important considerations for determining risk for dysphoria and depression.

INVESTIGATION OF SEQUENCING AS A KEY COGNITIVE ABILITY. Charlene Hendricks, L. Trueblood\*, A. Willson-Quayle, V. Malabonga\*, D. Cianco, & R. Pasnak, Dept. of Psych., George Mason Univ., Fairfax, Va. 22030. The study investigated the effects of instruction in class inclusion and sequencing for first graders with cognitive difficulties. Results showed instruction in both concepts was effective and translated into substantial gains in academic achievement and overall reasoning ability. Further, sequencing may represent a key cognitive operation during this transitional period.

CONTRIBUTIONS OF PARENTAL EMOTION LANGUAGE TO PRESCHOOLERS' SOCIAL COMPETENCE. Anita T. Kochanoff, Susanne Denham, & Camron Caswell\*, Depart. Of Psychology, George Mason University, Fairfax, VA 22030. In order to investigate the influence of parental emotion language on the social competence of preschoolers, this study examines emotion language with each parent separately and in two contexts: 1) in the natural home setting and 2) during a structured reminiscence task requiring parents and children to discuss emotions while removed from the actual experience. The functions of emotion language used by parents are examined within each of these two contexts. Children's emotional responses to peers' emotions were observed in the preschools to assess social competence. Mothers were found to reminisce more than fathers and particularly with their older daughters. Mothers also talked more about their own emotions. Fathers' guiding-socializing language and mothers' self-referent language predicted their children's social competence. Father's self-referent language seemed to be more predictive of girls' social competence, whereas mothers' self-referent language was a better predictor of their sons' social competence. The findings regarding gender differences both for parents and for the children are the first of their kind.

THE EFFECTS OF CULTURAL VALUES ON HUMAN RESOURCE MANAGEMENT PRACTICES. Jenny C. Y. Kuang & Donald D. Davis\*, Dept. Of Psychology, Old Dominion University, Norfolk, VA 23529-0267. This experiment studied the effects of 3 of Hofstede's (1984, 1991) cultural values of power distance, individualism and collectivism, and long-term and short-term orientation on human resource management practices. Data was collected from 125 undergraduate students at Old Dominion University using modified versions of the Chinese Value Survey (Chinese Culture Connection, 1987), Triandis' (1995) individualism questionnaire, and a constructed survey of power distance to assess the cultural values held by participants at an individual level. A constructed questionnaire of human resource management practices containing vignettes was used to assess whether the cultural values held by the participants affect level of agreement with, views of fairness of, and level of satisfaction with particular human resource management practices which represented the poles of the cultural values. No significant relationship was found between the assessment of vignettes and the participants' cultural values except for the rating of satisfaction for one vignette which represented the pole of high power distance. Limitations and directions for future study are discussed.

RELATIONSHIPS AMONG AFRICAN-AMERICAN FATHERING AND CHILDREN'S SOCIAL, BEHAVIORAL, AND COGNITIVE DEVELOPMENT. Judith I. Lehman, Michelle L. Kelley, and Nicole M. Ayers, Department of Psychology, Old Dominion University, Norfolk, VA 23529

The present study examines the relationships between fathering and child outcomes. The participants were 12 African-American "family units" (consisting of a 7 to 12 year old child, the child's mother, and the child's father/father figure). Fathers were interviewed about their disciplinary practices, work history, and day to day involvement with the child. Fathers also completed a questionnaire designed to assess children's internalizing and externalizing behavior. Mothers were administered the Vineland Adaptive Behavior Scale - Survey Form, the Child Behavior Checklist, and a background questionnaire. Children were administered the Coopersmith Self-Esteem Inventory and the Wide Range Achievement Test. A video recording also was made of the child and the father/father figure engaging in a problem solving discussion. It was hypothesized that the father/father figure's discipline practices, employment history, degree of involvement, and parenting style would be related to children's development. That is, authoritative parenting, greater daily involvement with children, and continued employment would be positively related to children's social development, behavior, academic achievement, and self-esteem. The hypotheses were examined using a factor analysis. A dimensional analysis was utilized to reduce the measures administered to both the father and the child to a single factor. These two factors were then used to perform the factor analysis.

FACTORS AFFECTING DIFFICULTY OF GENERATE AND TEST IN ALGEBRA PROBLEM SOLVING. Audrey W. Lipps, Irvin R. Katz\*, Dept. of Psychology, George Mason Univ., Fairfax, Va. 22030, & J. Gregory Traflet\*, Naval Research Laboratory. Generate-and-test strategy, sometimes called "guess and check," is being included in algebra and pre-algebra curricula, but the component skills have not been included in standardized assessments of mathematical skill or addressed thoroughly in empirical research of mathematical reasoning. The current research seeks to further understand how students use generate-and-test, and how particular problem features affect problem difficulty. We hypothesized that, for problems with multiple correct answers, the percentage of correct solutions within all possible solutions affects the problem difficulty. To test this, we manipulated the percentage of correct solutions for six problems. Each problem was instantiated in a base (unchanged) version, and two manipulated versions that resulted in relatively greater or lesser percentages of correct solutions. Thirty-nine undergraduates solved two problems of each version. Results showed that reducing the percentage of correct solutions made the problems significantly harder than the base version. Additionally there was marginal evidence that the presence of an additional constraint (the mechanism for manipulating the solution percentage) made the problem harder.

AN ASSESSMENT OF THE CONSTRUCT VALIDITY OF THE MYERS-BRIGGS TYPE INDICATOR, FORM G. C. Anthony Macera & Robert M. McIntyre\*, Dept. of Psych., Old Dominion University, Norfolk, VA 23529. The MBTI is currently used to assess personality in many organizational settings, but evidence of its construct validity is mixed. This study assessed its construct validity by means of three approaches. Confirmatory factor analysis was used to test the four-factor model implied by the authors of the MBTI. A convergent validity analysis investigated correlations between the MBTI scales and those of the NEO Five-Factor Inventory. A known-groups analysis investigated hypothesized relationships between the MBTI scales and occupational interest categories as classified by Holland's (1973) typology. Results from the confirmatory factor analysis indicated poor model fit. Results from the convergent validity analysis did show support for the hypothesized relationships between the MBTI and NEO scales. Results from the known-groups analysis supported only two of eight hypothesized relationships between MBTI types and occupational interest. The overall conclusion is that the MBTI is in need of improvement before it can be used with confidence. Suggestions are given for modifying the instrument to improve its construct validity.

HIPPOCAMPAL-DEPENDENT MEMORY ACROSS THE ESTROUS CYCLE IN THE RAT. J. A. Markham, S. A. McKnight\*, E. K. Spencer\*, and L. E. Jarrard, Dept. of Psychology, Washington and Lee Univ., Lexington, VA 24450. Recent findings concerning the relationship between estrogen and neural connectivity in the hippocampus have led to the hypothesis that performance of female rats on hippocampal-dependent tasks ought to be affected by different levels of estrogen. We wished to test this hypothesis further by using complex spatial vs. nonspatial tasks and examining the effects of different days of the estrous cycle on performance. Cycling female rats ( $N = 7$ ) were trained daily on a series of 4 tasks that were designed to test spatial vs. nonspatial intramaze cue learning, together with reference memory (RM) and working memory (WM). Two 8-arm radial mazes in separate rooms were used where one was arranged to test RM and the other to test WM. Comparison of performance on the days of proestrus vs. estrus indicated that performance was similar for the spatial task, the cue task, and for overall working memory. However, on proestrus days rats made significantly more RM errors than on estrus days. These findings indicate that the day of estrous cycle has a significant effect on RM but not on WM, and there is no effect on the acquisition of spatial as compared to nonspatial tasks. This pattern of behavioral change is different from the spatial impairments characteristically found in rats that have had the hippocampus removed (see Jarrard, 1995). Since reference memory in this experiment involved learning a complex discrimination, the results suggest that structures other than the hippocampus may be especially affected by the different levels of estrogen. Supported by a grant from NSF to LEJ.

IMPACT OF CULTURAL VALUES ON HUMAN RESOURCE MANAGEMENT PRACTICES. Susan K. McFarlin & Don D. Davis\*, Dept. of Psychology, Old Dominion Univ., Norfolk, Va. 23529. The present study examined the connection between cultural values and human resource management practices. Universalism vs Particularism, Achievement vs Ascription, and Relationship to Nature were measured in 102 male and female university undergraduates using a series of surveys in a take-home packet. Trompenaars' (1996) Universalism vs Particularism questionnaire, Trompenaars' (1985) Achievement vs Ascription questionnaire, and a newly developed scale tapping Relationship to Nature, were used to measure individual levels of each cultural value. An instrument consisting of workplace vignettes was implemented to measure the impact of participant cultural values on human resources management practices. No significant differences between Achievement vs Ascription-oriented and High v Low Harmony oriented (Relationship to Nature) individuals were found. Universalists scored significantly higher than Particularists on agreement and satisfaction ratings of universalist-oriented workplace vignettes. Also, Particularists scored higher than Universalists on agreement, satisfaction, and fairness ratings of particularist-oriented workplace vignettes. Results suggest that cultural values may shape management decisions.

EFFECTS OF WIN, A THC AGONIST, ON PERFORMANCE OF RATS WITH THE HIPPOCAMPUS REMOVED. Omar Moneim, L.W. Holloway, B. Bowring, and L.E. Jarrard, Dept. of Psychology, Washington and Lee Univ., Lexington, Va. 24450. Male rats were tested on spatial and non-spatial memory tasks to determine the effects of WIN, a THC agonist on normal animals and animals with the hippocampus removed. Running time and total errors were recorded on place and cue tasks for both working and reference memory. Rats with the hippocampus removed performed poorly on all tasks, but much worse relative to control animals on any task involving spatial memory. Although statistical analysis of running times on the working memory place task indicated that increased drug levels were impairing motor function, drug levels showed no significant affect on memory for either control animals or animals with the hippocampus removed.

EFFECTS OF CONTEXTUAL REDUNDANCY ON HABITUAL PROSPECTIVE MEMORY. Cheryl M. Puzon; Dept. of Psychology, Washington & Lee University, Lexington, VA 24450. Prospective memory (PM) is remembering to perform an action in the future. 81 Ss participated in a differing vs. identical background task divided attention condition during which they had to remember to press a target key at various intervals. The results demonstrated that those who had a continual variety of background tasks performed more poorly on the prospective memory target task than those who repeated the same background task for the same amount of time. The difference can be attributed to practice and consequent liberation of attentional resources over time to be allocated towards remembering of the PM target task. The study also found that participants' reality monitoring abilities correlated negatively with habitual PM task performance; thus, the retrospective memory component of reality monitoring is not an accurate predictor of habitual prospective memory abilities.

TRAINING ON CHAINING AND ITS EFFECTS ON WORKING MEMORY. Jennifer L. Scott, & Danielle S. McNamara\*, Dept. of Psyc., Old Dominion Univ., Norfolk, Va. 23508. Working Memory tasks, which are considered measures of working memory capacity, comprise a processing and a storage task. We examined whether training participants on a storage task would improve working memory capacity. Training involved teaching participants to create stories from lists of to-be-remembered words (i.e., chaining) within a short-term memory task (i.e., including only a storage task). It was hypothesized that short-term memory task performance would improve as a function of training and that learning this strategy would improve working memory task performance. There was a strong effect size for short-term memory task improvement, but working memory task performance showed only a moderate effect size for improvement. Lastly, there was a moderate effect size for an interaction between reading comprehension skill and working memory capacity.

THE EFFECTS OF COMPLACENCY POTENTIAL AND BOREDOM PRONENESS ON PERCEIVED WORKLOAD AND TASK PERFORMANCE IN AN AUTOMATED ENVIRONMENT. J. M. Stark & M. W. Scerbo\*, Old Dominion Univ, Norfolk, VA 23529. The effects of complacency potential and boredom proneness on performance and subjective workload in a multi-tasking automated environment were examined in this exploratory study. Interactions between automation condition and complacency potential as well as automation condition and boredom proneness were expected. Sixty participants were randomly assigned to one of three automation conditions: automatic, manual, and monitoring. Participants completed the Complacency Potential Rating Scale and Boredom Proneness scale prior to performing the Multi-Attribute Task Battery. Dependent measures consisted of subjective workload, assessed with the NASA-Task Load Index, the Task-Related Boredom Scale, and fuel management performance on the MAT task. Results showed effects for complacency potential and boredom proneness. The nature of these constructs in rich, multi-tasking environments is discussed.

## Statistics

BROADBAND ARRAY PROCESSING DIRECTION OF ARRIVAL ESTIMATION TECHNIQUES. Richard D. Bliss, Harry L. Van Trees, and Kristine Bell, School of Information Technology and Engineering, George Mason Univ., Fairfax, Va. 22030. Maximum likelihood and coherent subspace sensor array processing techniques have been developed to resolve and estimate the directions of arrival (DOA) from closely spaced narrowband signals at the same frequency. How these techniques have been extended to estimate the DOA of broadband signals covering the same frequency band is presented here. Focusing matrices are used as an efficient means to coherently combine the data correlation matrices associated with the narrowband components of the broadband data discrete frequency spectrum. Narrowband DOA estimation techniques can then be directly applied to a single focused broadband data correlation matrix. Some methods developed to construct and utilize focusing matrices are presented here and compared by determining their estimation accuracy against the broadband Cramer-Rao bound in Monte Carlo simulations. The results of these comparisons are evaluated to determine the most effective application of these techniques in particular signal and processing environments.

ESTIMATING THE VARIANCE OF A DESIRABILITY FUNCTION. Roger D. Gibb, Dept. of Biostat., Va. Commonwealth Univ., Richmond, Va. 23298, & Walter H. Carter, Dept. of Biostat., Va. Commonwealth Univ., Richmond, Va. 23298. Researchers in many areas of industry and science are faced with the problem of simultaneously optimizing multiple responses that depend on a common set of controllable variables. Since the responses typically have competing objectives, compromise must be incorporated in the estimation procedure. Desirability function methodology addresses this problem and has been proven effective in a wide range of applications. The current methodology, however, ignores the variances and correlations of the responses. We introduce a technique to incorporate these variances and correlations into the estimation procedure. We demonstrate our approach with an example and compare it with the existing methodology.

SUBSET DIAGNOSTICS IN MULTIVARIATE LINEAR MODELS. Donald R. Jensen, Dept. of Statistics, Va. Polytechnic Inst. and State Univ., Blacksburg, Va. 24061 and Donald E. Ramirez, Dept. of Mathematics, Univ. of Va., Charlottesville, Va. 22903. Diagnostics for normal errors in regression currently utilize ordinary residuals, despite the failure of assumptions validating their use. Case studies here show that such misuse may be critical even in samples of size exceeding currently accepted guidelines. A remedy is to employ linearly recovered errors having the required properties even in small samples. Details are supplied. In addition, effects on these revised diagnostics due to various model violations are examined.

ANDREWS PLOTS FOR MULTIVARIATE DATA: SOME NEW SUGGESTIONS AND APPLICATIONS. Ravindra Khattree\*, Dept. of Math. Sci., Oakland Univ., Rochester, MI 48309, & Davanand N. Naik, Dept. of Math. & Stat., Old Dominion Univ., Norfolk, VA 23529. Andrews plots (Andrews, 1972, Biometrics, vol. 28, pp. 125-136), as a tool to graphically interpret the multivariate data have recently gained considerable recognition. In this article, we first review the previous literature and then suggest a modification to the traditional Andrews plots. Finally, we illustrate a few new applications of these plots in robust design studies and in the correspondence analysis, using the real data.

CROWN PROFILE MODELING OF LOBLOLLY PINE BY NONPARAMETRIC REGRESSION ANALYSIS. James E. Mays, Dept. of Math. Sciences, Va. Commonwealth Univ., Richmond, VA 23284-2014, & Paul F. Doruska\*, Dept. of Forestry, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24060-0324. Crown profile of loblolly pine (*Pinus taeda* L.) was modeled by nonparametric regression analysis. Nonparametric regression may be applicable when an underlying parametric model cannot be identified, and uses only the data to fit a curve. A class of local-polynomial estimators which contains the popular kernel estimator as a special case was investigated. Kernel regression appears to fit closely to the interior data points but often possesses bias problems at the boundaries of the data, a feature less exhibited by local linear or local quadratic regression. A selection of trees were used to show that nonparametric regression captures more structure in crown shape than multiple linear regression. When using nonparametric regression, decisions must be made regarding polynomial order and bandwidth. Such decisions depend on the presence of local curvature, desired degree of smoothing, and for bandwidth in particular, the minimization of some global error criterion. In the present study, a penalized PRESS criterion (PRESS\*) was selected as the global error criterion.