

ABSTRACTS OF PAPERS

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Aeronautical and Aerospace Sciences

PROBABILITY AND POSSIBILITY-BASED METHODS FOR RELIABILITY ASSESSMENT OF A TUNED DAMPER SYSTEM. Christopher L. Gunther, Sophie Chen*, Efstratios Nikolaidis, Aerospace & Ocean Engineering Dept., Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. The objective of this paper is to compare probabilistic models and fuzzy set models for design against uncertainty when there is limited information about the statistics of the uncertainty or modeling error. First, we compare the axioms of probabilistic and fuzzy set methods and the rules governing the arithmetic operations that these methods use. Then, we compare the two methods in designing for maximum safety under a given budget for a tuned damper system. In general, if there is sufficient information to build accurate probabilistic models of uncertainties, probabilistic methods are better than fuzzy set methods. On the other hand, fuzzy set methods can be better if little information is available. One reason is that it is easier to identify the most conservative fuzzy set model than the most conservative probabilistic model that is consistent with the available information.

RADIATIVE HEAT TRANSFER IN REACTING SUPERSONIC NOZZLE FLOWS. S. B. Pidugu and S. N. Tiwari, Dept. of Mechanical Engineering, Old Dominion University, Norfolk, VA. 23529. The radiative interactions have been investigated in chemically reacting supersonic flows of premixed hydrogen and air in expanding nozzles using two dimensional spatially elliptic Navier-Stokes equations. The system of governing equations are solved using explicit, unsplit MacCormack predictor-corrector scheme. The chemistry source term is treated implicitly to alleviate stiffness associated with fast chemical reactions. The reaction mechanism is modeled by a seven species and seven reaction model. A pseudo gray gas model is employed in order to evaluate radiative heat transfer. The important radiative participating species in this problem is water vapor. The typical problem chosen for this study has inlet velocity of 1230 m/s, inlet temperature of 1900 K, inlet pressure of 1 atm, wall temperature of 1900 K, and the nozzle length of 2 m. Extensive parametric studies are conducted to investigate the effects of equivalence ratio, inlet Mach number and nozzle geometry on the flowfield characteristics as well as on wall heat fluxes. For chemically reacting supersonic nozzle flows, the effects of radiation on flowfield can be neglected but the radiative effects on the heat transfer on the nozzle walls are significant. The effect of Mach number on temperature and wall heat flux is significant when radiative interactions are included in the problem. The magnitude of radiative wall heat fluxes are found to be much higher than the conductive fluxes.

EFFECTS OF WING SIZE AND BODY CROSS-SECTION ON THE AERODYNAMIC CHARACTERISTICS OF A DELTA-WING-BODY CONCEPT AT HIGH SUPERSONIC MACH NUMBERS. M.Lerov Spearman, Systems Analysis Branch, NASA-Langley Research Center, Hampton, VA 23681 & Jill C. Harper, Aerospace and Ocean Engineering Dept, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. An analysis has been made of some existing wind-tunnel data for the purpose of assessing the aerodynamic behavior of a family of airplane designs for the flight range between about $M=3$ and 5. This speed range is about the upper limit for the use of conceptual turbine engine propulsion systems and hydrocarbon fuels as well as for the use of current materials and structures technologies. It is also a region in which the aerodynamics begin to change from linear to nonlinear and thus there are some concerns over the design of aircraft or missiles for operation in this speed range. The experimental results are for Mach numbers from 2.30 to 4.63 for several wing-body-tail models having 70 degree delta wings. Geometric variations included changes in wing area and change in body cross-section from circular to elliptical. The effects of various trades between wing size and body cross-section on the aerodynamic characteristics will be shown for this region in which the wing lift begins to decrease and the body lift becomes more significant.

A HIGH-SENSITIVITY FOCUSING SCHLIEREN SYSTEM. D.A. Spraggins, B. M. Tabibi *, and J. H. Lee *. Research Center for Optical Physics, Hampton University, Hampton, VA 23668. Recently the focusing schlieren (FS) technique has attracted worldwide interests for flow visualization because global and easily-interpretable images of refractive-index gradient fields in dimensions as large as in flight air space. However the technique has not been applied to low-density ($\sim 10^{22} \text{m}^{-3}$) flows of super/hyper-sonic flight. We present a high-sensitivity FS System designed, constructed and tested with the High Speed Flow Generator (HFG) of NASA Langley Research Center which provided supersonic flows in a free-jet expansion. The bow-shock and boundary layers around an obstacle have been depicted well by the system enabling determination of the flow-density limit for visualization. This work is supported by NASA grant NAGW1-2929.

EFFECTS OF SUPERSONIC VITIATED/CLEAN AIR ON IGNITION/COMBUSTION CHARACTERISTICS OF HYDROGEN FUEL, PART I: CODE VALIDATION. A.A.Taha, and S.N. Tiwari, College of Engineering and Technology Old Dominion University, Norfolk, VA 23529. The effect of heating the incoming air in the scramjet engine combustion using vitiation concept is studied numerically. Two cases are studied. A subsonic tangential fuel injection is treated two-dimensionally with the combustion mode switched on. Both vitiated and clean incoming air were used. The vitiation has the advantage of increasing both the mechanical and thermal power of the engine. Also the paper presents the results of 3-D numerical study of staged normal injection of two air jets behind a rearward facing step into a Mach 2 airflow. The objectives of the present paper are to establish computer code (Fluent) credibility through validation study and to evaluate the applicability of the code to simulate realistic scramjet combustor flow fields, particularly for midspeed combustor operation. The current work represents an intermediate step toward obtaining accurate numerical results to address the differences between vitiated and clean air ignition/combustion data. Specific attention is directed to determine the differences in ignition delay time using pure hydrogen, hydrogen/hydrocarbons mixture, and hydrocarbon fuels. Validation of the code has been obtained by comparing the computed predictions of the 3-D staged normal injection case with existing experimental data. The present code solutions compare favorably with experimental data.

Agriculture, Forestry and Aquaculture Science

AN OVERVIEW OF FISH DIAGNOSTIC CASEWORK FROM VIRGINIA'S AQUACULTURE INDUSTRY: 1993-1998. David Crosby, Cooperative Extension, PO Box 9081, Virginia State University, Petersburg, VA 23806. Fish health problems in Virginia's emerging aquaculture industry vary with producer expertise, culture systems, and species. Since 1993, the number of cases presented to the VSU Fish Health Diagnostic Laboratory has fluctuated annually, peaking in 1995 with 73 cases and dropping to 28-30 cases per year thereafter. The casework has shifted from catfish and hybrid striped bass in production ponds and cages to tilapia inspections from recirculating systems. No single disease group has dominated as a disease problem for Virginia fish producers. However, parasitic problems are the main cause of disease outbreaks in cages and recirculating systems. Parasites constituted about 30% to 40% of casework submissions. Proliferative gill disease has been confirmed from pond reared catfish in Virginia. *Ichthyobodo* has been identified as a commonly found parasite on the skin of fish in recirculating systems. Since 1997, emphasis on treatments to control disease outbreaks has changed to education, training, and fish health inspections to prevent disease outbreaks.

HEMOGLOBIN METABOLISM IN SICKLE CELL ANEMIA. Jacqueline M. Hibbert, Paul Swerdlow*, John Clore*, Luke Wolfe*, Farook Jahoor* and Alan Jackson*. Virginia Commonwealth University and Baylor College of Medicine, USA, Southampton University, UK. Homozygous sickle cell disease (HbSS) is characterized by increased rates of red blood cell (RBC) destruction and removal from the circulation. Consequently, there is increased RBC synthesis and hemoglobin metabolism, but the magnitude of the increase has not been measured. We developed a method to measure hemoglobin metabolism *in vivo* in health and disease using the stable isotope ^{15}N -glycine, since glycine is required in large quantities for heme synthesis and is quantitatively excreted via bilirubin once the red cell dies. Nineteen normal healthy subjects (HbAA) and 4HbSS were given a 12 h infusion of ^{15}N -glycine and blood was collected at 0, 12 and 24 h. Heme and glycine were isolated from the RBC, the incorporation of ^{15}N into these isolates was measured by mass spectrometry and the results used to calculate fractional hemoglobin synthesis rates (fSynHb). fSynHb was 20 times higher for the HbSS patients compared with the HbAA volunteers. These results suggest an increased need for the building blocks of the protein hemoglobin. This may limit other protein synthesis and produce the characteristics of protein energy malnutrition observed in HbSS.

BOTANICALS AND NATURAL ENEMIES FOR PEST MANAGEMENT IN GREENHOUSE VEGETABLES. Mark E. Kraemer and Joseph McConnell*, Agricultural Research Station, Virginia State University, Petersburg, VA 23806. Commercially available botanical products were tested for efficacy against larvae of the greenhouse whitefly (*Trialeurodes vaporariorum* Westwood) and compared with the synthetic pesticides Endosulfan and Malathion. The Rotenone/Pyrethrin mixture and insecticidal soap treatments resulted in over 85% control, significantly greater than the less than 40% control by the synthetic pesticides ($P < 0.05$). Fewer whitefly eggs were laid on garlic extract and hot pepper wax treated plants than water controls but not significantly at the 5% level. In addition, a system was devised to determine whether natural enemies of pests utilize flower resources. High mortality of the minute pirate bug was found when caged with dill flowers with cut stems in a water soluble pesticide.

PROTEIN LEVEL EFFECTS ON LIVER AND MUSCLE COMPOSITION OF HYBRID STRIPED BASS. A. I. Mohamed, Agricultural Research Station and Scott H. Newton, Cooperative Extension Service, Virginia State University, Petersburg, VA 23806. Hybrid striped bass (HSB) is becoming one of the more popular aquaculture fish in Virginia. Growth rate of HSB varies and depends upon pond conditions and feed constituents. To reduce production costs of HSB, the primary objective of this study was to evaluate reduction of crude protein in commercial bass rations. Commercially prepared rations typically range from 38% to 44% in crude protein content. Rations used in this study had 38% (high protein feed, HPF) and 34% (low protein feed, LPF) crude protein, respectively. Fish averaging 0.25 pounds each were stocked and fed twice daily six days a week from spring until fall harvest. Water quality of ponds was monitored throughout the experiment. After harvest, liver and fillet samples were collected and total lipids, fatty acid profiles, protein, and glycogen were determined. Significant differences were found in total lipids in liver and fillet samples between the two rations. Liver of HSB on HPF had 7.84% total lipids compared to 10.75% in LPF. However, HSB on HPF had significantly higher ($p > 0.05$) total saturated fatty acids than those fed LPF. Liver protein also was significantly higher than those on LPF. Similar trends were found with fillet; percent total lipids and protein were 0.93, 1.83, and 18.7, 16.6 % for HPF and LPF, respectively. Total unsaturated fatty acids in fillet was higher in HSB fed the high protein ration. No significant difference was found in glycogen content of the liver and fillet between feeds.

CORONARY HEART DISEASE PROTECTION BY SOYBEANS: BEYOND PLASMA LIPID CONCENTRATION. A.I. Mohamed, Agricultural Research Station, Virginia State University, Petersburg, VA 23806 & Anwar S. Abd El-Fattah, 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. Several studies were conducted to determine the role of isoflavones in controlling CDH. Using hypercholesterolemic rabbit as a model, the studies indicated that purified soyprotein diet significantly reduced cholesterol level in serum from 395 to 62 mg/100 ml. Using a scale from 1 through 4, the studies showed significant reduction in arterial damage from 2.3 for rabbits on casein diet to 1.0 for those fed purified soy protein diet. When soy flour was incorporated into diet, cholesterol level was significantly reduced from 395 to 127 mg/100 ml serum with arterial damage of 0.09. The higher reduction in arterial damage of soy flour diet may be due to a higher level of phytochemical contents. A study to determine the cardioprotection efficacy of soybean isoflavones extract against acute myocardial infarction (MI) was conducted. The data showed that administration of crude soybean extracts (10mg/Kg, iv.) protected against sustained coronary artery occlusion and reperfusion in a rabbit model of acute MI.

MODELING GREEN WEIGHT OF LOBLOLLY PINE (*Pinus taeda* L.). Bronson P. Bullock & Harold E. Burkhart, Dept. of Forestry, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. Green weight and green weight per unit volume relationships for loblolly pine trees have not been studied extensively and models for predicting weights across broad geographic areas are not readily available. Thus, the following basic interrelated issues were addressed in this study: 1) an examination of weight per unit volume relationships, 2) an assessment of how tree, stand, and geographic characteristics affect weight per unit volume relationships, 3) a derivation of models of weight per unit volume for predicting total bole weight and merchantable weight, 4) a derivation of models for predicting green weight directly, and 5) a comparison of results from applying approaches 3) and 4). This study showed that green weight per unit volume varies by height within individual stems. However, green weight per unit volume was not related to stand characteristics, and the mean value showed no consistent trend across geographic areas. Data from four data sets were combined and region-wide prediction models for total green weight, green weight to any upper merchantable diameter, and green weight to any upper merchantable height were developed for loblolly pine trees.

PROTEIN LEVEL EFFECTS ON LIVER AND MUSCLE COMPOSITION OF HYBRID STRIPED BASS. A. I. Mohamed, Agricultural Research Station, and Scott H. Newton, and Cooperative Extension Service, Virginia state University, Petersburg, VA 23806. The Hybrid Striped Bass (HSB) is becoming one of the most popular fish in Virginia. The growth rate of HSB varies and depends upon pond condition and feed constituents. To reduce production costs of HSB, the primary objective of the study was to evaluate reduction of crude protein in commercial bass rations. Commercially prepared rations typically range from 38% to 44% in crude protein content. Rations used in this study had 38% (high protein feed, HPF) and 34% (low protein feed, LPF) crude protein, respectively. Fish averaging 0.25 pounds each were stocked and fed twice daily six days per week until harvest. Water quality of the ponds were monitored throughout the experiment. After harvest, liver and fillet samples were collected and total lipids, fatty acid profiles, protein and glycogen were determined. Significant differences in total lipids in liver and fillet between the two feeds were found. Liver of HSB on HPF had 7.84% total lipids compared to LPF 10.75%. However, HSB on HPF had significantly higher ($p>0.05$) total unsaturated fatty acid than that fed LPF. Liver Protein was significantly higher than those on LPF. Similar trend was also found in fillet, percent total lipids and protein were 0.93, 1.83, and 18.7 for HPF and LPF, respectively. Total unsaturated fatty acids in fillet was higher in HSB fed on high protein diet. No significant difference in glycogen content of the liver was found between feeds.

CORONARY HEART DISEASE PROTECTION BY SOYBEANS: BEYOND PLASMA LIPID CONCENTRATION. A.I. Mohamed, Agricultural Research Station, Virginia State University, Petersburg, VA 23806 & Anwar S. Abd El-Fattah, 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. Several studies were conducted to determine the role of isoflavones in controlling CDH. Using hypercholesterolemic rabbit as a model, the studies indicated that purified soyprotein diet significantly reduced cholesterol level in serum of from 395 to 62 mg/100 ml. Using a scale from 1 through 4, the studies showed significant reduction in arterial damage from 2.3 for rabbits on casein diet to 1.0 for those fed purified soyprotein. When soy flour was incorporated into the diet, cholesterol level was significantly reduced to 127 mg/100 ml serum, however, arterial damage was 0.09 which is significantly lower than that of purified soy protein. The higher reduction in arterial damage may be due to a higher level of phytochemical contents soy flour. A study to determine the cardioprotection efficacy of soybean isoflavones extract against acute myocardial infarction (MI) was conducted. The data showed that administration of crude soybean extracts (10mg/Kg, iv.) protected against sustained coronary artery occlusion and reperfusion in a rabbit model of acute MI.

CAGE CULTURE OF RAINBOW TROUT IN VIRGINIA. Scott H. Newton, Cooperative Extension, Virginia State University, Petersburg, Va 23806. Research has been conducted since 1985 at Virginia State University on winter culture in non-traditional trout production areas of Virginia. Studies have focused primarily on use of cages in farm ponds. Research experiments, along with industry production results, have shown that winter cage culture of rainbow trout (and, also brook trout) is biologically feasible and commercially profitable in Virginia. Typically, fish averaging 4 to 5 per pound are stocked in the fall and harvested the following spring. The most desirable harvest size is 14 to 16 ounces, although almost all fish sizes are marketable. Water temperature is the most important factor effecting growth. Optimum trout production occurs when the water temperature is constant in the range of 58 to 62 degrees Fahrenheit. Winter water temperatures fluctuate during the production season, but growth occurs throughout the temperature range of 45 to 70 degrees. Fish harvest must be completed when water temperature reaches the 65 to 70 degree range.

OPPORTUNITIES FOR SMALL SCALE AQUACULTURE IN VIRGINIA. Anthony Provenzano, Dept. of Ocean, Earth and Atmospheric Sciences, Old Dominion Univ., Norfolk Va. 23529-0276. Basic principles of aquatic culture can be learned at small scale, especially for closed systems. There is opportunity for low volume culture of very valuable species for niche markets. Commercial small scale production systems and information about construction and operation are now widely available. These systems are not for food production, so entrepreneurs need to think in terms of ornamental, bait or research species. Booming marine aquarium keeping and technology has made feasible the keeping and growing of tropical marine invertebrates such as shrimp, corals, anemones, and plants as well as fishes. Market value of such species is many times that of food species and markets can be local pet shops, wholesalers or direct retail sales. The large and growing water garden industry requires hundreds of varieties of plants and animals which can be produced on small scale and sold to local water gardening centers. The producer should market directly to the final user wherever possible.

EFFECTS OF THINNING RESPONSE MODIFICATIONS TO INDIVIDUAL TREE GROWTH MODELS. James A. Westfall and H. E. Burkhart, Dept. of Forestry, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. Effects of thinning, such as increased diameter growth and decreased mortality in the residual stand, are largely the result of increased tree vigor induced by a decreased level of competition. These relationships are reflected in the models that are central to PTAEDA2, a growth and yield simulator developed for loblolly pine (*Pinus taeda*) plantations. A long-term thinning study served as a basis for attempting to improve the predictive output of PTAEDA2. Model parameters were estimated using data from plots that received different thinning intensity treatments. Height increment and mortality models were found to need no additional refinement and were re-fit using all available data. Diameter increment and crown ratio model forms could not account for thinning effects in their original form and thinning response functions that exhibit proper behavioral response were added to these models. Models were evaluated individually and in combinations in a reduced growth simulator that contains the growth subroutines from PTAEDA2. Results show predictive ability improved when using the diameter increment model with thinning response variable. Prediction of crown ratio suffered when the crown ratio model with thinning response variable was utilized.

SEASONAL VARIATION AND BREED EFFECTS IN COMPONENTS OF THE BREEDING SOUNDNESS EXAMINATION IN MALE GOATS. S. Wildeus, Agricultural Res. Station, Va. State Univ., Petersburg, VA 23806. Breeding soundness examinations were conducted in bucks of various breeds in a project evaluating an accelerated (8-mo) mating system for meat goat production. Mating occurred twice in November (breeding season), July (transitional season), and March (non-breeding season). Breeding Bucks were evaluated prior to each mating period for scrotal circumference, and sperm motility and morphology. Semen samples were collected by electroejaculation. A total of 115 observations were recorded, representing 70 different bucks. Data were analyzed for effects of mating season (November, July, and March) and breed (Myotonic, Nubian, Pygmy, and Spanish). Ejaculate characteristics were evaluated after arcsine conversion of percentages. Body weight ranged ($P < .01$) from 61 kg in Nubian to 33 kg in Pygmy bucks, and was not different between mating seasons. Scrotal circumference was not affected by mating season, but was higher ($P < .05$) in Spanish and Nubian bucks (26.0 and 25.2 cm, respectively), than in Myotonic and Pygmy bucks (23.4 and 25.2 cm, respectively). Scrotal circumference reflected the differences in body weight, however, adjustments for body weight reversed this ranking, with Pygmy bucks having a higher ($P < .01$) adjusted scrotal circumference, followed by Myotonic, which were again higher than Spanish and Nubian. Ejaculate wave motion score (range: 1 to 3) and motility estimates were lower ($P < .05$) in Myotonic bucks (1.9 and 66%) than in the other breeds (> 2.1 and $> 72\%$), but were not different between mating seasons. In contrast, normal sperm in the ejaculate were not affected by breed, but were higher ($P < .05$) in the breeding (88.9%) than the transitional season (65.1%), which was higher ($P < .05$) than in the non-breeding season (32.5%). The results indicate that breed type and season need to be considered in interpreting breeding soundness examinations in goats.

SPECIES DIFFERENCES IN THE INTAKE OF VEGETABLE SOYBEAN BIOMASS IN SMALL RUMINANTS. S. Wildeus¹, T. Mebrahtu¹, T. D. Wilson and W. F. Brown^{2*}, ¹Agricultural Res. Station, Va. State Univ., Petersburg, Va. 23806 and ²Inst. of Food and Agricultural Sciences, Univ. of Florida, Ona, FL 33865. In a previous pilot trial we were able to achieve acceptable intake of vegetable-type soybean biomass (SB) in goats. This follow-up trial was designed to confirm these results and evaluate the use of SB for hair sheep, another small ruminant species. A group of 7-mo old female Katahdin ewes (n=6; body weight: 48 kg) and Boer cross does (n=6; body weight: 34 kg) were fed a composite of genotypes SB, harvested at the green pod stage (R6-R7). Following pod removal, whole SB was air-dried under cover and samples were analyzed for nutritional quality (97.5% dry matter, 86.0% organic matter, 15.1% crude protein, 44.6% NDF, and 57.6% *in vitro* organic matter digestibility). Animals were placed into 2.5 x 3.0 m individual pens and allowed to adjust to the pens. SB was fed in quantities to ensure *ad libitum* access (> 1.3 kg) in 115 L plastic garbage cans, modified with key hole feeders, without further supplement. Stems > 0.5 cm diameter were removed prior to feeding. Animals were fed at 0900 h and the previous day's refusal was weighed back at this time. Due to lack of consumption and severe weight loss (2.9 kg in ewes and 4.0 kg in does, representing 5.9% and 11.9% of body weight, respectively) the trial was terminated after 6 d. The limited intake that was observed was higher ($P < .05$) expressed on the basis of metabolic body weight in ewes (37.2 g/kg^{0.75}) than in does (20.8 g/kg^{0.75}). There was no difference in the nutritional quality of SB offered and SB refused. The reason for the limited consumption of SB in this trial is not readily apparent, as nutritional quality (crude protein and *in vitro* dry matter digestibility) was higher than in the earlier trial. Research is needed to evaluate effects of animal age and sex, and forage processing on SB intake in small ruminants.

NUTRITIONAL QUALITY OF VIRGINIA-GROWN TEPARY BEAN SEED. Robert A. Wood and Harbans L. Bhardwaj, Agri. Res. Stn., Va State Univ., Petersburg, Va 23806. Tepary bean (*Phaseolus acutifolius* A. Gray), a desert plant native to the southwestern United States, is known to be highly drought and heat tolerant. Our objectives were to determine if tepary bean can be grown in Virginia and to compare the nutritional quality of Virginia-grown seed to that produced in the southwestern United States. Eight tepary bean lines and three planting times (May 29, June 19, and July 10) were evaluated in replicated field experiments during 1997. The seed produced were analyzed for mineral composition and oil characteristics. Analysis of Variance indicated that tepary bean lines differed for seed yield (1167 to 1769 Kg/ha) and contents of potassium, 16:0, 22:0, and poly-unsaturated fatty acids whereas planting time had significant effects on seed yield (1011 to 1822 Kg/ha) and contents of protein, potassium, calcium, boron, zinc, manganese, 20:0, 18:2, 20:1, and poly-unsaturated fatty acids. The mean protein and oil contents of Virginia-grown tepary bean seed were 26.5 and 2.2%, respectively as compared to 13 to 29% protein and 0.4 to 2% oil content, respectively in seed produced in southwestern United States. Contents of most minerals in Virginia-grown seed were comparable to those produced in southwestern United States. Based on yield and nutritional quality characteristics, tepary bean seems to be a potential new crop for Virginia.

Archeology

THE PROBLEM WITH SECTION 106 COMPLIANCE SIGNIFICANCE: DOGGED ANTHROPOLOGY, HYPERRELATIVISM, SCIENTISM, AND OTHER GENERAL HOWLING AT THE MOON. Michael B. Barber, George Washington & Jefferson National Forests, 5162 Valleypointe Parkway, Roanoke, VA 24019. The National Historic Preservation Act of 1966 provided for the protection of archaeological resources under Criterion D as those "that have yielded, or may be likely to yield, information important in history and prehistory." This has usually been interpreted as those sites which contain high research value. A significant portion of the problem in determining research value rests with most archaeologists' background in anthropological theory. Various anthropological paradigms are examined with regard to research value including general anthropology, post-processual archaeology, scientism, and cultural relativism. A case is made for the determination of research value based on the values held by the American citizenry with the guidance of archaeological specialists. Public education is seen as fundamental in the process.

DEMOGRAPHY AND PATHOLOGIES OF INDIVIDUALS FROM EIGHTEENTH AND NINETEENTH-CENTURY AFRICAN-AMERICAN CEMETERIES. Cliff Boyd & Donna Boyd*, Dept. of Soc. and Anth., Radford Univ., Radford, VA 24142. Sixty-three African-American individuals from three Virginia cemeteries are described and compared to other antebellum and postbellum African-American skeletal populations from the South. These three cemeteries range in date from the early eighteenth to the late nineteenth centuries and provide information on the skeletal biology of both slave and free black individuals. Some common patterns for all individuals examined include overall poor dental health and a robust postcranial skeletal structure, reflecting heavy and long-term physical labor.

KWAKIUTL MASK: HUMAN/ANIMAL TRANSFORMATIONS AND MATERIAL CULTURE. Josh Duncan, Mary Washington College. The Northwest Coast of North America provided the setting for a unique group of Native Americans known as the Kwakiutl. The thrust of this paper will be to discuss the transformative powers that accompany the masks used by the people during ceremonies, as well as use the mask to discover the fundamental binary oppositions that are visible throughout the cultural structure the Kwakiutl created.

INTERACTION IN THE LOWER RAPPAHANNOCK VALLEY, AD 1000-1650. Michael J. Klein, Center for Historic Preservation, Mary Washington College. The scale-dependent, at times fractal nature of the archaeological record demands data analysis at several levels. Archaeologists commonly recognize this principle, recording assemblage distributions within a hierarchy of spatial scales from the unit and strata to the region. Similarly, from a world-systems perspective, economic and social interaction embraces local, regional and large scale processes. In complex systems, where change may result from the interplay of many variables operating at different spatial and temporal scales, cause and effect may be neither spatially nor temporally proximate. This paper attempts to sketch the AD 1000-1650 trajectory of social evolution in the lower Rappahannock Valley by reviewing evidence for regional interaction and exchange as local, regional, and large scale phenomena.

PRELIMINARY RESULTS OF INDUCTIVELY COUPLED PLASMA ATOMIC EMISSION SPECTROMETER ANALYSIS ON RHYOLITE SAMPLES FROM 44GY18 AND 30MG201. Mark Martin, George Washington/Jefferson National Forests, 5162 Valleypointe Parkway, Roanoke, VA, 24019. ICP analysis has been conducted on rhyolite samples from a prehistoric base camp/possible reduction station located at the base of Mt. Rogers in Grayson County, Virginia and from a prehistoric quarry site located in the Uwharrie Mountains of central North Carolina. The analysis suggest an elemental "thumbprint" exists for the tested material from each location. The results of the tests were compared to highlight the variability between key elements within the sample populations. The findings show substantial variation exists among the same elements between the samples.

EXTRACTIVE INDUSTRIES IN SOUTHWEST VIRGINIA AND THEIR EFFECT ON THE POPULATION AND ITS COMMERCE AND OTHER SELF-EVIDENT ELUCIDATIONS. Robert P. Meyer Jr., George Washington and Jefferson National Forests, 5162 Valleypointe Parkway, Roanoke, Va. 24019. The extractive industries of southwestern Virginia have impacted the land and people of the region for many generations and will likely continue to do so, well into the coming century. The industries themselves mining or timbering may change as technological improvements come about or the resource in question is exhausted, but the effect on the people who live and work amongst the various mining and logging concerns has little to do other than continue making them dependent upon the industry. The cycle of work and unemployment seems to follow the extractive industries through all of the communities concerned and tends to leave the land blighted with huge tailings piles, eroded clear cuts, clogged and polluted waterways and the population in the area in a higher expectation of the standard of living that the industry allowed when it was still viable.

PUTTING THE PEOPLE BACK IN LIGNITE: A SYNCHRONIC APPROACH TO A DIACHRONIC PROBLEM. George A. Tolley, George Washington and Jefferson National Forests, 5162 Valleypointe Parkway, Roanoke, Va. 24019. The community of Lignite was an iron mining company town located in northwestern Botetourt County, Virginia. The town, built between 1896 and 1908, underwent change, expansion, decline, and ultimately desertion. Old maps, photographs, oral histories, census records, and county tax records, were examined to supplement the results of an archaeological survey that was conducted at this town. Each of the documents reveals evidence from a moment in time and when taken together can help us draw conclusions about changes in the community over its lifetime.

Biology

EVOLUTIONARY SIGNIFICANCE OF INSERTIONS/DELETIONS IN THE *MATK* GENE. L. A. Alice and K. W. Hill. Dept. of Biology, Va. Polytechnic Inst. & St. Univ., Blacksburg, VA 24061. Indels have been identified at the extreme 3' end of the chloroplast gene *matK* and were examined in detail in the Poaceae. Bryophytes and gymnosperms have longer open reading frames (ORF) than angiosperms. Of the three indels identified in the Poaceae, two are not a multiple of three causing a frameshift. The parsimony informative indels are optimized on two alternative phylogenetic models based on other data sets. These synapomorphic indels provide insight into the position of basal taxa and distinguish major lineages of grasses. A 1-bp (base pair) deletion supports the positions of *Streptochaeta* and *Anomochloa* as the two most basal lineages in Poaceae. A 6-bp insertion supports the monophyly of subfamilies Panicoideae, Arundinoideae, Centothecoideae, and Chloridoideae (PACC). This marker may have potential in providing insight into the sister-group relationship between PACC and other lineages. Another 1-bp deletion resulting in early termination of the ORF is unique to *Ehrharta*, a member of the taxonomically disputable tribe Ehrharteae. Alignment of deduced amino acid sequences from bryophytes, gymnosperms, and angiosperm species shows that this region is relatively conserved, but variation is notably higher in Poaceae. The evolutionary implications of these changes in grasses and other plant families are addressed. (Supported by NSF Grant # DEB 9634231 to KWH)

EFFECTS OF INDOMETHACIN TREATMENT ON LIPOPOLYSACCHARIDE-INDUCED PREGNANCY LOSS IN CD-1 MICE. J. Bailey 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. Lipopolysaccharides (LPS) released from Gram-negative bacteria cause pregnancy loss, possibly by inducing secretion of inflammatory prostaglandins. The effect of the anti-inflammatory drug indomethacin (IND) on the frequency of LPS-induced pregnancy loss was studied in CD-1 mice. IND-treated mice received 5 µg/ml IND and 0.095% ethanol in drinking water on days 7 through 12 of gestation. LPS-treated mice were injected intravenously with 5 µg of *E. coli* LPS in 0.05 ml of PBS on day 9 of gestation. Control mice received 0.095% ethanol in drinking water and/or were injected with PBS. LPS treatment caused a significant decrease in maternal weight and a significant increase in frequency of pregnancy loss. Treatment with IND reduced LPS effects, but the differences were not statistically significant. These results suggest that prostaglandins are involved in LPS-induced pregnancy loss, but the dose of IND used was insufficient to fully inhibit prostaglandin synthesis.

IDENTIFICATION OF FUNCTIONAL BINDING DOMAINS ON MAIZE β-GLUCOSIDASE RECOGNIZED BY AN AGGREGATING FACTOR. David Blanchard, Muzaffer Cicek*, and Asim Esen. Dept. of Biol., Virginia Tech, Blacksburg, VA 24061-0406. In maize, β-glucosidase is involved in several functions including carbohydrate and hormone metabolism, lignification, and defense against pests through the release of toxic aglycones and cyanide. Maize β-glucosidase occurs as 120 kD homodimers, but also forms high molecular weight (HMW) aggregates. The specific binding of a 32 kD β-glucosidase aggregating factor (BGAF) forms the HMW heterocomplexes. To identify functional domains and elucidate the mechanism of enzyme aggregation, we have generated chimeric β-glucosidases between two isozymes from Maize (Glu1 and Glu2) and their sorghum homolog, (Dhurrinase-1: Dhrl). Binding assays demonstrate that BGAF binds to both Glu1 and Glu2, which share 90% amino acid identity, but does not bind to Dhrl, which shares 70% amino acid identity with Glu1 and Glu2. In both chimera G1D (N-Glu1-Dhrl-C) and chimera G2D (N-Glu2-Dhrl-C) the C-terminal 47 amino acids of maize Glu1 and Glu2, respectively, were replaced with the C-terminal 53 amino acids of Dhurrinase-1. Binding assays showed that G1D and G2D remained catalytically active but lost BGAF binding activity. However, when the C-terminal 23 amino acids on G1D were exchanged with the C-terminal 17 amino acids from maize Glu1 (N-Glu1-Dhrl-Glu1-C) binding activity was restored. We postulate that the resulting apolar surface patch plays a key role in BGAF recognition and binding.

METABOLIC RATE AND THERMAL ACCLIMATION OF PRAIRIE RATTLESNAKES (*Crotalus viridis viridis*). Charles R. Blem and Elena R. Herasme, Dept. of Biol., Va. Commonwealth Univ., Richmond, Va. 23284. The effects of acclimation on the metabolic rates and energy budgets of 7 rattlesnakes (*Crotalus viridis viridis*) were studied by measuring oxygen consumption (VO₂) at constant temperatures of 17, 22, 27 and 32°C. Snakes acclimated to 22°C had the highest metabolism when exposed to changes in ambient temperature. Snakes acclimated to 27°C had a slightly lower metabolic rate under the same conditions. When the snakes were acclimated to 32°C, however, their metabolic rates as well as their sensitivity to the changes in ambient temperature were significantly lower overall. Based on our results in this study, we predicted that acclimation could save > 50% of the snake's energy budget during the summer months of the year.

EFFECTS OF IBUPROFEN TREATMENT ON LIPOPOLYSACCHARIDE-INDUCED PREGNANCY LOSS IN CD-1 MICE. B. Bordewyk 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. Lipopolysaccharides (LPS) released from Gram-negative bacteria cause pregnancy loss, possibly by inducing secretion of inflammatory prostaglandins. The effect of the anti-inflammatory drug ibuprofen (IBU) on the frequency of LPS-induced pregnancy loss was studied in CD-1 mice. IBU-treated mice received 60 µg/ml IBU and 0.095% ethanol in drinking water on days 7 through 12 of gestation. LPS-treated mice were injected intravenously with 5 µg of *E. coli* LPS in 0.05 ml of PBS on day 9 of gestation. Control mice received 0.095% ethanol in drinking water and/or were injected with PBS. LPS treatment caused a significant decrease in maternal weight and a significant increase in frequency of pregnancy loss. Treatment with IBU failed to alter these LPS effects. These results indicate that the normal therapeutic dose of IBU was insufficient to inhibit prostaglandin synthesis or that prostaglandins are not essential to LPS-induced pregnancy loss.

EFFECT OF COMBINING MOLECULAR DATA SETS ON PHYLOGENY IN CHLORIDOIDEAE (POACEAE, GRASSES). G. G. Borneo, L. A. Alice and K. W. Hilu. Dept. of Biology, Va. Polytechnic Inst. & St. Univ., Blacksburg, VA 24061. The Chloridoideae is one of the seven large subfamilies of grasses, and includes five tribes, 145 genera, and about 1,357 species. The subfamily is distinguished primarily on the basis of anatomical and physiological characters. To address systematic questions in the Chloridoideae, two DNA sequence data sets were generated from the maternally inherited chloroplast gene *matK* and the biparentally inherited nuclear ribosomal internal transcribed spacer region (ITS). Twenty-three species representing 18 chloridoid genera and one outgroup species were sequenced. The *matK* data set comprises 1,542 characters of which 20% are variable and 9% are parsimony informative. The ITS data set includes 708 characters of which 53% are variable and 39% are parsimony informative. Parsimony analyses using PAUP were done for each data set. The *matK* analysis recovered 45 equally parsimonious trees. Several polytomies were evident in the strict consensus tree. The ITS analysis yielded one tree, the results of which are highly congruent with the *matK* consensus tree. Because there does not appear to be significant conflict between the two data sets, a combined analysis was performed. A single, fully-resolved tree was obtained with increased levels of support than for either data set separately. The consistency of results based on nuclear and chloroplast DNA sequences provide strong support for the relationships identified in this study. (Supported by NSF Grant # DEB 9634231 to KWH)

EVOLUTIONARY RELATIONSHIPS IN *ORYZA* INFERRED FROM THE PROLAMIN (SEED STORAGE PROTEIN) GENE. Irene M. Boyle & Khidir W. Hilu, Dept. of Biol., Va. Polytechnic Inst. & State Univ., Blacksburg, Va 24061. *Oryza* encompasses two cultivated and approximately 20 wild species. Rice is a socioeconomically important crop; it feeds more people worldwide than any other crop and is second only to wheat in terms of worldwide crop production. Seventeen of *Oryza* species are delineated into the diploid genomes A, B, C, E, F, and the polyploids BBCC and CCDD while five species contain unidentified (?) genomes. Cultivated *O. sativa* and *O. glaberrima* contain the AA genome. Sequences of the gene encoding the 10 kDa prolamins were used in a cladistic study to examine the phylogeny of *Oryza* with *Phyllostachys aurea* as an outgroup. *Oryza meyeriana* (?) (Philippines), *O. granulata* (?) (Laos), *O. australiensis* (EE) (Australia), and *O. brachyantha* (FF) (Cameroon), all geographically diverse species, represent the most basal lineages. Species containing a CC genome (CC, BBCC, CCDD) plus *O. punctata* (BB) form a lineage. Within the latter lineage, *O. minuta* (BBCC) forms a clade with *O. rhizomatis* (CC) possibly arising through concerted evolution. A strongly supported clade emerged containing *O. punctata* (BB) and species of the South American-endemic CCDD genome. Species relationships were not resolved within the AA genome. (Supported by: Sigma Xi Grant-in-Aid of Research, The Virginia Academy of Science, and the Graduate Research Development Project [GRDP], Va. Polytechnic Inst. & State Univ.).

SURVEY SUMMARY OF ROAD KILL GRAY SQUIRRELS IN FAIRFAX COUNTY. Walter Bulmer, Biology Dept., Northern Virginia Community College, Annandale, VA 22003. An increase in the Gray Squirrel population of suburban Fairfax County was suspected based on observations during the summer of 1992. A survey was designed to record numbers of road casualties as a possible indicator of population increase. Fifteen student and faculty observers recorded the number of squirrels dead on the road as they commuted to the Annandale campus of N.V.C.C. The survey was conducted for 25 days within the time period between 16 September to 21 October. The miles of county roads surveyed by each participant were recorded to derive the number of road kills per mile of observation. During the survey 276 actual road kills were recorded on 969 miles of Fairfax County roads. The sum of road kills per mile observed times the total number of miles of county roads yielded an estimated number of road kill squirrels throughout the county per day. The grand total estimate for the 25 day survey period was 41,271 road kills in all. The peak activity occurred from 16 September to 6 October which corresponds to the dispersal of young squirrels from parental territories. A suggestion was made to move the squirrel hunting season to coincide with this peak activity period. It was hypothesized that Red-tail Hawks are the major predator on Gray Squirrels. The high squirrel population in Fairfax County was correlated with relatively low numbers of Red-tailed Hawks in suburbia.

EFFECTS OF TAMOXIFEN ON REPRODUCTIVE SUCCESS AND DEVELOPMENT OF THE EXTERNAL GENITALIA IN CD-1 MICE. J. Carney and A. F. Conway, Dept. of Biol., Randolph-Macon Col., Ashland, Va. 23005. CD-1 mice were given 0, 3, 6, or 9 $\mu\text{g/ml}$ tamoxifen citrate in their drinking water from day 7 through day 18 of gestation. No significant increase in pregnancy loss was associated with tamoxifen treatment. Increasing doses of tamoxifen resulted in decreasing maternal weight gain during pregnancy. Weights of both male and female fetuses were higher in mice treated with 3 $\mu\text{g/ml}$ tamoxifen than in controls, but were significantly reduced by treatment with 9 $\mu\text{g/ml}$ tamoxifen. The tamoxifen doses used had no effect on external genitalia in female fetuses, but the ano-genital distance in male fetuses was significantly reduced by treatment with 9 $\mu\text{g/ml}$ tamoxifen. These results suggest that doses of tamoxifen above the typical human dose may pose a risk of fetal growth retardation and feminization of the external genitalia in male fetuses.

PHYLOGENETIC RELATIONSHIPS OF THE GENERA OF FISHES OF THE FAMILY SPARIDAE (PERCIFORMES) BASED ON OSTEOLOGY. Kent E. Carpenter, Dept. Biol., Old Dominion Univ., Norfolk, Va. 23529. The genera of Sparidae are currently grouped in either four or six subfamilies based mostly on dentition and feeding types. I tested the monophyly of these subfamilial groups through a phylogenetic analysis of the genera. Forty-five osteological characters were surveyed among 47 sparoid taxa, including 30 of the 32 recognized genera of Sparidae. A subset of these characters were phylogenetically informative, including some newly discovered character states. This includes specializations of the premaxillary-maxillary distal articulation. A simple groove and lateral projection originating on the ventro-distal edge of the premaxilla is typical of denticine maxillary articulation; a dorso-lateral laminar projection originating about one-third up from the ventral edge of the premaxilla typifies boopsine articulation; and, a strong rod projecting ventro-laterally from the ventro-distal edge of the premaxilla typifies all sparine genera. A preliminary cladistic parsimony analysis refutes the monophyly of some of the currently recognized subfamilies. For example, *Crenidens crenidens*, included in the Boopsinae by most authors, has osteological character states more consistent with the subfamily Sparinae.

SYSTEMATICS OF THE GENUS *SELENE* (PERCIFORMES: CARANGIDAE). Martin J. deGravelle and K.E. Carpenter, Dept. of Biological Sciences, Old Dominion University, Norfolk, VA. 23529. The marine fish genus *Selene* (Perciformes: Carangidae) currently consists of seven species, present in both the Atlantic and Pacific oceans. This study attempts to reconstruct the evolutionary relationships within *Selene* and with closely related carangid genera, and address questions of conspecificity among certain *Selene* species. Primary characters used for analysis come from osteological structures, mainly from the post-cranial skeleton. External morphology was also utilized in this study. Osteological features were examined using both radiographs and clearing and staining techniques. *Alectis* spp. and *Carangoides otrynter* served as outgroups. On the basis of these analyses, it was shown that presence and variation of the neural and haemal spine processes, cephalic profile shape and length, persistence of anal fin spines, length of dorsal and anal fin lobes, the ratio of the soft anal fin to soft dorsal fin bases, and the structure of the anterior anal fin spine pterygiophore are highly informative for determining the phylogeny and taxonomy of *Selene*. These characters will segregate the genus into two different species groups, with the *S. setapinnis* group being the most derived. However, the position of *S. oerstedii* remains unresolved. It may either be the most primitive member of the genus or more closely related to *C. otrynter* than to other *Selene*.

FLEAS (SIPHONAPTERA) OF SMALL MAMMALS FROM SIERRA DE LAS MINAS, GUATEMALA. Ralph P. Eckerlin, Natural Sci. Div., Northern Va. Cmnty. Col., Annandale, VA 22003; S. G. Perez and N. Ordóñez Garza, Museo de Historia Natural, Univ. de San Carlos, Guatemala City, Guatemala; J. O. Matson, Dept. of Biol. Sci., San Jose State Univ., San Jose, CA 95192; and T. J. McCarthy, Section of Mammals, Carnegie Museum of Natural History, 5800 Baum Blvd., Pittsburgh, PA 15206. Collections were made of small mammals by live, snap, and pitfall trapping at 2 sites above 2000m in cloud forest in Sierra de las Minas in Guatemala. Among 1614 fleas, *Plusaetis vermiformis* (47%), *Ctenophthalmus sanborni* (24%), and *Baculomeris schmidti* (12%) were common at both sites. *Baculomeris schmidti* had not been collected since 1934. A *Jellisonia* at San Lorenzo was replaced by a *Kohlsia* at Los Albores, both on *Peromyscus grandis*. Undescribed species of *Ctenophthalmus* and *Hystriechopsylla* were obtained from shrews, *Sorex veraepacis*; host and fleas have northern affinities biogeographically as does the rare flea *Atyphloceras*. Central American endemic genera are *Baculomeris*, *Jellisonia*, *Kohlsia*, and *Plusaetis*. Supported by National Geographic Society, U.S. Food and Drug Administration Food Safety Initiative, Carnegie Museum of Natural History, Sanofi-Winthrop Co., and NVCC Educational Foundation.

TELOMERASE ACTIVITY IN MOUSE HEPATOCYTES AND HEPATOMAS. S. Glad and R. Barra, Dept. of Biological Sci., Mary Washington College, Fredericksburg, VA 22401. Telomerase is the enzyme utilized by the cell to prevent telomere shortening resulting from repetitive cellular divisions. There is evidence that suggests that increased levels of telomerase occur in 80-90% of human tumor samples, leading to the assumption that telomerase plays a role in cancer development by acting as a survival mechanism for the cell. This experiment utilized the TRAP assay to examine telomerase levels in mouse hepatocytes and hepatoma cells. Initial studies on cultured mouse hepatoma cells were not positive for telomerase activity. The study, therefore, focused on mice treated with a potent liver carcinogen, aflatoxin B₁. The kidney, liver, lung and spleen of control and treated animals were tested for telomerase activity over a four week period. It was found that upon initial exposure to the carcinogen that there was an increase in telomerase activity. This increase was transient, and by four weeks the enzyme activity had returned to normal. The results suggest, that in this short term study, an insufficient number of cells were transformed to alter the levels of enzymatic activity.

AFTER THE STORM: RECOVERY OF COTTON STAINERS FROM HURRICANE IMPACT. Harold J. Grau, Dept. of Biol., Chem., & Env. Sci., Christopher Newport Univ., Newport News, VA. 23606. Cotton stainers (*Dysdercus* sp.) are pan-tropical hemipterous insects that feed primarily on Malvaceous plants. Several distinct populations of *D. andreae* are found on St. Thomas, USVI. In September of 1995, and again in July of 1996, the island suffered direct hits by tropical hurricanes. As might be expected, the populations of *D. andreae* exhibited severe reductions in densities and distribution, being totally eliminated from several locations. By 1998, 3 of 5 populations studied had made significant recoveries in terms of densities and habitat utilization, although they were still below pre-hurricane levels; the fourth population had not returned at all, and the fifth population was the same as in August 1996 (which was already more densely distributed than in the pre-hurricane years). Measures of body sizes from 3 populations showed an overall trend of returning to pre-hurricane averages. The data indicate that the insects' recovery in the two-year period following the storms has been significant but incomplete. (check out the stainer web site! <http://users.cnu.edu/~hgrau/>)

SKEWED DISTRIBUTION OF SPECIES NUMBER IN GRASS GENERA: IS IT A TAXONOMIC ARTIFACT? K. W. Hilu, Dept. of Biology, Va. Polytechnic Inst. & St. Univ., Blacksburg, VA 24061. The Grass family (Poaceae) is comprised of about 10,000 species distributed in some 785 genera and seven large and a few small subfamilies. The distribution of species in genera appears skewed toward monotypic or few species per genus. This pattern follows the Hollow Curve theory as documented by J. C. Willis for various families. Explanations for the pattern is believed to involve mathematical, statistical, biological, and psychological reasoning. This study explores potential biological and statistical explanation for species distribution in the Poaceae. Subfamilies representing basal and terminal clades in grass phylogeny were compared, and species distribution in all subfamilies was investigated for the influence of habit and habitat. The species distribution curve is not only skewed for the number of small genera but also for the total number of species in larger genera. Age of the group does not appear to effect curve shape but has an impact on the size of larger genera. This impact could also be due to the unique reproductive strategies of the basal Bambusoideae used in this particular comparison. Differences in species distribution are evident in predominantly biennial grass genera while annuals and perennials display the typical hollow curve.

EFFECTS OF FLUNIXIN ON PROSTAGLANDIN F2ALPHA AND E2 CONCENTRATIONS IN PERIEMBRYONIC TISSUES OF NORMAL AND LIPOPOLYSACCHARIDE-INDUCED RESORBING IMPLANTATION SITES IN CD-1 MICE. J. E. Le Lay 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. Lipopolysaccharide (LPS) from Gram-negative bacterial cell walls induces pregnancy loss, apparently by stimulating a cytokine cascade which in turn induces production of inflammatory prostaglandins. Paradoxically, the prostaglandin synthesis inhibitor flunixin meglumine (FM) decreased pregnancy loss in LPS-treated pigs but increased pregnancy loss in LPS-treated mice. Therefore the inflammatory prostaglandin F2alpha (PGF2alpha) and the protective prostaglandin E2 (PGE2) were measured in periembryonic tissues from mice injected intraperitoneally with FM on days 8 and 9 of gestation, mice injected intravenously with LPS on day 9 of gestation, mice injected with both, and control mice. Embryos from mice treated with both FM and LPS contained elevated PGF2alpha levels and the ratio of PGE2 to PGF2alpha was reduced in the embryo and in periembryonic tissues. These results indicate that FM in combination with LPS inhibited PGE2 production more than PGF2alpha production in periembryonic and embryonic tissues and actually stimulated PGF2alpha production in the embryo. This pattern may have increased pregnancy loss in these animals.

OSTEOLOGICAL COMPARISON OF THE PERCOID FAMILIES LETHRINIDAE AND SPARIDAE. 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. This study focuses on relationships between two percid families, the Lethrinidae and Sparidae. The Lethrinidae is currently recognized as five genera and a total of thirty-nine species; the Sparidae is composed of thirty-five genera and one hundred twelve species. These families are categorized into the most abundant and diverse fish order, the Perciformes. This order is characterized by immense adaptive plasticity; thus, many character complexes observed in this order are plagued with parallel and convergent evolution mechanisms. The relationships within the superfamily Percoidae prove especially confusing; many families within the Percoidae are not properly delimited which has led to improper family evaluations and the creation of inconsistent genera. This study attempts to provide an osteological definition for comparison of the closely related Lethrinidae and Sparidae. Specimens were cleared with trypsin and stained with alizarin red S stain to examine seven meristic characters and eleven anatomical characters from three lethrinid genera and twelve sparid genera. The most phylogenetically informative meristic characters included the number of epipleural ribs, dorsal fin spines and rays, trisegmental pterygiophores, gill rakers, and procurent rays. The most phylogenetically definitive anatomical characters included the first interneural shape and width, urohyal shape, shape of the first and second basibranchial, length of the third basibranchial, and tooth structure in the upper jaw, dentary, and pharyngeal region. These osteological characters provided informative comparisons that clearly distinguished the Lethrinidae from the Sparidae.

MOLECULAR MONITORING OF MICROBIAL POPULATIONS DURING BIOREMEDIATION OF CONTAMINATED SOILS. D. K. Mills¹, K. Fitzgerald¹, P. M. Gillevet*², C.D. Litchfield¹, ¹Dept. of Biol., ²Inst. for Biosciences, Bioinformatics & Biotechnology, George Mason Univ., Fairfax, VA 22039. Bioremediation is a cost-effective technology for the remediation of many petroleum-contaminated sites. Much attention is paid to the contaminant degradation, but many times the microorganisms are neglected in the studies. Molecular techniques can be used to profile the complexities of natural microbial communities. Contaminated soils were used to inoculate up-lift slurry bioreactors with nutrient amendments being continuously fed to treatment reactors versus only water to the control reactor. Eleven sampling events were conducted during the month long experiment. Direct DNA extraction and subsequent amplification by PCR using universal primers amplified whole community 16S ribosomal genes. PCR products were cleaved with restriction enzymes and separated by gel electrophoresis. Techniques using fluorescent primers and DNA sequencing instruments proved to greatly enhanced the resolution and the ability to monitor the diversity and dynamics of the microbial community. Whole community DNA fingerprints had unique banding patterns as the nutritional status within the bioreactors changed over time. The different DNA profiles reflect the beneficial effects of nutrient amendments for enhancing the degradation of contaminants. Therefore, molecular techniques can provide enhanced understanding of microbial community dynamics and monitor the biotic changes during bioremediation.

PARALLEL EVOLUTION IN MARQUESAN LAND SNAILS. James Murray, Dept. of Biol., Univ. of Va., Charlottesville, VA 22903, Bryan Clarke*, Div. of Genetics, Univ. of Nottingham, NG7 2UH, England, and Michael S. Johnson*, Dept. of Zoology, Univ. of Western Australia, Nedlands, Western Australia, 6907. The land snails of the family Partulidae inhabiting the Marquesas Islands are of two types. There are robust, thick-shelled species and fragile, thin-shelled forms. These species also differ in pigmentation of the shell, stickiness of the mucus, and length of tentacles. Allozyme electrophoresis shows that the Marquesan species are a monophyletic group within the genus Samoana. The two suites of characters have apparently evolved independently at least twice in the Marquesas, once in the northern islands and once in the south. Similar morphotypes appear in both Partula and Samoana of the Society Islands. The parallel evolution of these suites of characters argues that these complexes have arisen through the action of natural selection during the adaptive radiation of the groups.

THE EFFECTS OF IL-2 AND IL-12 ON LYMPHOCYTE ACTIVATION. N. Simpson and R. Barra, Dept. of Biological Sci., Mary Washington College, Fredericksburg, VA 22401. IL-2, an activation factor for helper T-cells, B-cells, cytotoxic T lymphocytes, and natural killer cells (NK), and IL-12, a cytotoxic lymphocyte maturation factor and NK stimulatory factor, were added to isolated human lymphocytes and their effects were compared to IL-15 a factor known to stimulate differentiation of NK cells into Lymphokine Activated Killer Cells (LAK). ME-180 cells and small lung cell carcinomas were incubated two days with lymphocytes treated with either 200 ng/ml of IL-2 or 20 ng/ml of IL-12. Only the ME-180 cells were incubated two days with lymphocytes treated with 25 ng/ml of IL-15. The IL-15 treated lymphocytes were the most effective, reducing the number of viable ME-180 cells to 20%. IL-12 was non-selective, having equal but minimal effects on the ME-180 and small lung carcinoma cells. The IL-2 had a greater effect on the ME-180 cells than the small lung cells. The results of the study indicate that IL-12 is not by itself effective in stimulating the killing activity of lymphocytes.

EFFECT OF DEPLETION OF NATURAL KILLER CELLS ON FREQUENCY OF PREGNANCY LOSS INDUCED BY TREATMENT OF CD-1 MICE WITH INTERLEUKIN-2 AND LIPOPOLYSACCHARIDE. K. E. Smith 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. The involvement of natural killer (NK) cells in pregnancy loss resulting from mixed infections was studied in CD-1 mice. The effect of a mild Gram-negative infection was modelled by intravenous injection of 2 μg of *E. coli* lipopolysaccharide on day 9 of gestation. The systemic effect of a viral or intracellular bacterial infection was modelled by intraperitoneal injection of 0.5 μg of mouse IL-2 on days 7 and 9 of gestation. NK cells were depleted by intravenous injection of rabbit anti-asialoGM1 gamma globulin on day 7 of gestation. IL-2 alone had no effect on frequency of pregnancy loss, but IL-2 significantly increased the frequency of pregnancy loss resulting from LPS injection. Anti-asialoGM1 treatment negated the IL-2 stimulation of LPS-induced pregnancy loss and slightly increased pregnancy loss in response to LPS. These results indicate that NK cells contribute to IL-2-stimulated LPS-induced pregnancy loss.

EXPRESSION OF THE P53 PROTEIN AND ITS CORRELATION WITH P21 GENE IN DNA DAMAGED ME-180 CELLS. C. L. Stallings and R. Barra, Dept. of Biological Sci., Mary Washington College, Fredericksburg, VA 22401. Cancer is a disease characterized by a loss of cell cycle control, which results in the rapid proliferation of cells within a tissue. Although different cells utilize many different control mechanisms, one common in humans involves the tumor suppressor gene p53 working with the p21 gene in response to DNA damage. With DNA damage, p53 may act as a transcription factor and turn on p21, which then interacts with cdk-cyclin complexes to induce cell arrest. The goal of this study was to determine if there is an increase in the expression of the p53 gene in DNA damaged ME-180 cells and whether or not it correlates to an increase in the amount of the p21 Waf1 protein. Western blot and isotope labeling experiments showed that following exposure to the carcinogen methyl methane sulfonate, ME-180 cells increased their transcription of the p53 gene. This rise in p53 activity did not, however, have an effect on the quantity of p21 present in the cells. This might be due to a mutation within the signal transduction pathway involving p53 and p21 that disabled the transcription of p21.

MOLECULAR CLONING AND CHARACTERIZATION OF DHURRINASE-2 (CYANOGENIC β -GLUCOSIDASE) FROM SORGHUM. Sukanda Vichitphan and Asim Esen, Dept. of Biol., Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061-0406. The coding sequence of the mature cyanogenic β -D-glucosidase (Dhurrinase-2) of sorghum was cloned into the vector pET21a and expressed in *E. coli*. Dhr2 was expressed in soluble form and active. The recombinant Dhr2 (r-Dhr2) exhibits the same level of activity towards natural substrate dhurrin and other artificial substrates, as does its native counterpart isolated from sorghum seedlings. The optimization of Dhr2 expression conditions was done by induction with different concentrations of IPTG and at different temperatures. The final concentration of IPTG from 0.2 to 0.8 mM for induction yields the same Dhr2 activity based on activity assay using oNPG (o-nitrophenyl- β -D-glucopyranoside). The temperature of induction at 28°C and 37°C shows no difference in the amount of Dhr2 expressed. Western blot analysis using maize- β -glucosidase antisera confirmed the presence of Dhr2 and its molecular size (monomer) was identical to that of the native Dhr2 isozyme (62 kDa). Zymogram assays in native gels stained with the fluorogenic substrate 4-MUG (4-methylumbelliferyl- β -D-glucopyranoside) clearly showed that r-Dhr2 had the same electrophoretic mobility and substrate specificity as its native counterpart.

COMPARING AGE AND GROWTH OF LARVAL SPOT (*LEIOSTOMUS XANTHURUS*): IMPLICATIONS ON SHOREWARD TRANSPORT AND POPULATION STRUCTURE. Thomas R. Wasaff, Dept. of Biol. Sci., V.A. Old Dominion Univ., Norfolk, Va. 23529, & C.M. Jones, Applied Marine Research Lab., Old Dominion Univ., Norfolk, Va., 23529. The recruitment mechanisms responsible for transporting larval fishes from offshore spawning areas into estuaries and bays, during the fall and winter months, is not completely understood. As part of the South Atlantic Bight Recruitment Experiment (SABRE) spot (*Leiostomus xanthurus*) were collected between October 1994 and April 1995 as they entered Pamlico Sound through Oregon Inlet, located north of Cape Hatteras, and Ocracoke Inlet, located south of Cape Hatteras. In order to determine age structure, age and growth data were obtained from lapillar otoliths. The data indicate spot larvae enter Ocracoke Inlet earlier and at higher abundance than those entering Oregon Inlet. Mean ages of larvae caught for a given sampling date are similar for both inlets, suggesting the same transport mechanisms are acting on larvae ingressing both inlets. This also suggests that larvae entering each inlet are from the same population. Wind data, of importance to transport, was obtained from the Diamond Shoals weather buoy. Mean daily wind speed and direction shows potential correlation with spawning and recruitment abundance. In addition to the weather buoy, satellite imagery provided information on sea surface temperature. When possible, daily peaks in recruitment abundance were compared to satellite imagery in order to ascertain whether warmer water was associated with higher recruitment abundance.

Biomedical and General Engineering

DESIGN, FABRICATION, AND TESTING OF AN IMPEDOMETRIC CELL TRACKING ELECTRODE.

John Alexander, B.Sc., Gary L. Bowlin, Ph.D., Gary Wnek, Ph.D., Oliver Böglér, Ph.D., Department of Biomedical Engineering, Virginia Commonwealth University, Richmond, VA. 23298. The use of Electric Cell-Substrate Impedance Sensing (ECIS) is relatively new. This new electrode uses impedometric principles instead of optical techniques such as image analysis or laser tracking to determine the position of a mobile cell in a predefined channel. The ease of use and real time data acquisition ability are the major advantages. This new electrode adapts the fundamental theory of the electrode developed by Applied Biophysics, which records cell motility, to record cell position along a channel. As cells travel down a pre-defined channel, they will cross over exposed gold electrodes (source electrodes). Current flows from the source electrode to a large reference electrode located elsewhere in the media, above the channel for instance. As cells cover parts of the source electrode, there will be a detectable increase in impedance between the source electrode and the reference electrode. The electrode allows quantification of cell speed in real time. A cell's speed (and direction of movement) can be observed when the cell is exposed to various substances such as chemoattractants, growth factors, and hormones. Factors that attract or repel cells are important in immunology, neural, and cancer research and can now be quantified relatively easily and quickly with this new device.

DEVELOPMENT OF A THERMAL SYSTEM AROUND THE HUMAN BODY. A.F.

Alfahaid, S. K. Chaturvedi* and S.N. Tiwari, Department of Mechanical Engineering, Old Dominion University, Norfolk, VA 23529. The present study pertains to the three dimensional numerical study of characterization of thermal environment around human body. The ultimate aim of this study is to develop a three dimensional computational human thermal model which will enable accurate prediction of the thermal environment around a human body. Unstructured grid has been used to model a new complicated shape for the human body. Low-Reynolds-Numbers $k-\epsilon$ turbulence model is employed in computational fluid dynamic simulations. Two kinds of boundary conditions namely, constant skin temperature and constant heat flux, are applied to solve the governing equations for mass, momentum and energy transport. Comparison of numerical results with previous experimental data, included in the study, shows a good agreement.

FINITE ELEMENT ANALYSIS OF HUMAN THERMAL SYSTEM. S.C. Boregowda, and

S.N. Tiwari, Department of Mechanical Engineering, Old Dominion University, Norfolk, VA 23529. The present study pertains to the development of a novel approach to examine the human thermal system. An Objective Thermal Stress Index (OTSI) is developed by applying the second law of thermodynamics to the human thermal system to quantify thermal stress or discomfort in the human body. The human thermal model based on the finite element method is implemented. It is utilized as a "Computational Environmental Chamber" to conduct a series of simulations to examine the human thermal stress responses under different environmental conditions. An innovative hybrid technique is developed to analyze human thermal behavior based on series of human-environment interaction simulations. The continuous monitoring of thermal stress is demonstrated with the help of OTSI. Further, the OTSI is validated against the experimental data.

ENGINEERING THE MIND-BODY INTERACTION: A SEARCH FOR A GLOBAL STRESS INDEX (GSI) TO QUANTIFY HUMAN STRESS LEVEL. S.C. Boregowda¹, S. N. Tiwari¹, and O.S. Palsson², ¹Dept of Mechanical Engineering, Old Dominion Univ., Norfolk, VA 23529, and ²Dept. of Family Medicine, Eastern Virginia Medical School, Norfolk, VA 23507. The present study pertains to the development of a thermodynamic theory to quantify mental stress based on physiological responses. There has been a lot of interest to develop "mind-centered" flight decks for safety and performance. In the field of medicine, stress has become one of the leading causes for many chronic illnesses resulting in huge healthcare costs. Thus, there is a need to develop mathematical models based on strong scientific principles to link both psychological and physiological processes. This study addresses these issues through the development of a Global Stress Index (GSI) based on the second law of thermodynamics and Maxwell relations. The GSI provides a quantitative measure of mental stress in terms of physiological responses (blood pressure, heart rate, skin temperature, electromyogram, and skin conductance level) in the form of a single summative number. The GSI could become a standard measure of clinical stress for evaluating the effectiveness of different therapies in the treatment of stress-related disorders.

THE DEVELOPMENT AND CHARACTERIZATION OF A GELATIN BASED TISSUE ADHESIVE.

Kristen Droesch Dept of Materials Science and Engineering, Va. Polytechnic Inst. & State Univ., Blacksburg, Va. Experiments have been conducted to evaluate the structure and properties of a gelatin based tissue adhesive to be used in wound closure and other binding applications related to medicine. Several formulations of a specific adhesive system known as Gelatin Resorcinol Dialdehyde (GR-DIAL) have been developed. The effects of both cross-linking (glyoxal) and plasticizing (water) agents have been investigated with respect to material properties of aged and unaged samples. Thermal analysis has been conducted utilizing Differential Scanning Calorimetry (DSC), Dynamic Mechanical Spectroscopy (DMS) and Thermogravimetric Analysis (TGA). Aging at 37°C and swelling of the adhesive in water were conducted. Tensile testing has been conducted to analyze the strength and modulus of the adhesive. Lap shear adhesive bond testing has been conducted on glass substrates to analyze the adhesive strength. Thermal analysis has shown that increased cross-linking agent increases the proportion of bound water in the system. This was evidenced by a depression in the glass transition temperature (T_g), a decrease in the change of enthalpy of the ice melt in the adhesives, and two maxima in the evaporation rate of water from the adhesives. Aging studies have shown that water is lost by the system, however, the amount of water loss is decreased for the most cross-linked system. Swelling studies have shown that the most cross-linked adhesives absorb less solvent (water). Stress-strain testing shows that the adhesive is elastomeric when fresh but becomes brittle with water loss due to aging. Lap shear adhesive bond strength testing shows strength values as high as 23 kPa, and 106 kPa for aged adhesive bond specimens. These results show that GR-DIAL is a very flexible adhesive system, and quite applicable to wound closure and tissue binding applications.

PROCESSING COLD SOLDER JOINTS WITH MECHANICAL INTEGRITY BY SINTERING SOLDER

PASTE. Nicole S. Erdman and Mark A. Palmer, Department of Mechanical Engineering, Virginia Commonwealth University, Richmond VA 23284. Throughout the history of the electronics industry, the conventional solder has been eutectic tin-lead. Due to environmental concerns about lead, and a desire to operate at higher temperatures, alternatives are being considered. Most alternatives being considered melt at higher temperatures than eutectic tin-lead and would necessitate a change in equipment for manufacturers. To avoid forming cold solder joints, manufacturers have typically used materials that are at or close to eutectic composition. We feel that it may be possible to form solder joints from solder paste with a wide thermal range by using a process called liquid phase enhanced sintering. If one sinters at temperatures just above the solidus, a small amount of liquid will form around the powder particles and increase the rate of diffusion. In this study, two such pastes have been investigated. The mechanical integrity has been proven to be tangible, with joints prepared having shear strengths of 6 MPa and higher. This will allow manufacturers to consider alternatives to lead-tin that would not be considered for through-hole assemblies.

IMPACT OF WASHOUT BLADES IN A MULTIPLE DISK CENTRIFUGAL BLOOD PUMP. Michelle J. Holmes and Gerald E. Miller, Ph.D., Dept. of Biomedical Eng., Va. Commonwealth Univ., Richmond, Va. 23298. The blood flow pattern in a ventricular assist device is of interest because eddy formations and stagnation zones in blood flow are known to promote hemolysis and thrombosis. Hemolysis decreases red blood cell function and can increase the rate of coagulation, leading to greater thrombosis formation. Thrombosis formation in an artificial blood pump will eventually lead to pump failure and can prove to be fatal. Flow patterns in a multiple disk centrifugal blood pump were evaluated using a particle tracing flow visualization technique. A Helium-Neon laser was used along with a sheet lens to illuminate neutrally buoyant particles that were suspended in water. A mock circulatory loop consisting of a venous reservoir, a capacitor and a resistor was used to simulate physiological conditions. The system pressure, the motor speed, and the outlet flow rate were evaluated continuously. Prior studies revealed that recirculation occurred in the area of the pump between the last disk and the pump housing. As a result, blades were attached to the back of the last disk as an attempt to washout the area. Reevaluation of the flow patterns using the same method of visualization showed that the use of the blades was successful in producing washout and therefore eliminating flow recirculation. Removal of recirculation reduces thrombus formation, prolonging the life of the pump, thus benefiting the patient.

BODY WEIGHT SETPOINT AND HUMAN STARVATION. Frank P. Kozusko, Dept. of Math., Hampton Univ., Hampton, Va. 23668. A biological setpoint for fatness has been proposed in medical literature. In an underfed state with resulting weight loss the body may reduce the relative energy expenditure which reduces the rate of weight loss. Previous mathematical models of energy expenditure and weight loss dynamics have not address this setpoint mechanism. The setpoint model has been proposed to model this biological process. The setpoint model predicts that energy expenditure during weight loss is dependent on the fat free mass ratio existing at the setpoint weight. The setpoint model is applied to the seminal Minnesota Human Semistarvation Experiment and is used to predict weight versus time on an individual basis and the caloric requirements for weight maintenance at the reduced weight. Comparison is made with a constant energy-per-pound model and the Brody-Kleiber ($W^{3/4}$) Law.

TWO TYPES OF HEAT STIMULATION IN A STUDY OF SMALL NOCICEPTIVE NERVE FIBERS IN MAN. V. V. Itskovich¹, S. W. Harkins^{2*}, and D. Y. Fei^{1*}, ¹ Dept. of Biomedical Engineering, Va. Commonwealth Univ. (VCU), Richmond, VA. 23298, and ² Dept. of Gerontology, VCU. Heat pulses in the nociceptive range, generated by contact thermode and carbon dioxide laser, were applied to ventral aspects of arm and leg in 10 healthy subjects. Contact thermal stimuli consisted of 52 °C pulses (adapting temperature 39 °C; rise time of 500 ms; maximum heating slope 32.5°C/sec; probe diameter 9 mm; temperature values are for skin-probe interface). Laser generated radiant heat stimulus duration was 15 ms which corresponds to 52 °C temperature at receptor sites (laser power was 20 Watt, wavelength 10.6 μm, maximum slope 1306 °C/sec, beam diameter 7 mm). Psychophysical responses to each type of stimulus included pain quality and quantity as well as pain onset reaction times (RTs). Cerebral evoked potentials (EPs) to both types of stimulation at arm and leg were measured. Stimulation with both laser and contact probe produced two distinct pain sensations: a sharp and stinging sensation followed by a second dull and burning sensation. The EPs from laser and contact heat differed in morphology. EPs to laser stimulation consisted of the expected complex of a positive-negative-positive waveform shape (P150-N200-P300 at arm and P200-N270-P370 at leg), being most prominent at positive 300 milliseconds (P300) and positive 370ms (P370) for arm and leg respectively. EPs to contact thermal stimulation consisted primarily of a single positive wave (P800 at arm and P870 at leg), which matches latency time from laser stimulation, taking into account difference in rise time between contact and radiant stimuli. The latencies of subjective RTs and of EPs as well as the difference in latencies between arm and leg suggest that A-δ type II fibers were activated by both laser and contact heat stimulation of hairy skin. The combined subjective and physiological data support possible use of fast rise time heat pulses in the study of sensory changes following small fiber injury or peripheral neuropathy.

CARRIER LIFETIME DETERMINATION BY MICROWAVE CAVITY PERTURBATION, Roy Kessick and Gary Tepper, Dept. of Chemical Engineering, Va. Commonwealth Univ., Richmond, VA 23284. The performance of many semiconductor devices including radiation detectors, semiconductor lasers, and light emitting diodes depends strongly on the lifetime of charge carriers. Carrier lifetime is influenced by the presence of impurities that can act as recombination centers and is therefore a convenient measure of the quality or purity of a material. However, conventional photo-conductive lifetime measurements introduce additional parameters including carrier mobility, electric field uniformity, surface recombination and electrode capacitance that complicate the accurate determination of lifetime. Microwave cavity perturbation (MCP) has been used for years as a contactless probe of semiconductor properties including lifetime and effectively eliminates the problems associated with contacts and charge migration. Here we report on our initial investigations of the temperature dependence of carrier lifetimes in silicon using a pulsed laser microwave cavity perturbation technique. Changes in the microwave absorption coefficient of silicon crystals upon pulsed optical illumination are detected as a change in the reflected power from a loaded cylindrical resonator.

ENGINEERING OF POLYMER SURFACES BY RAPID EXPANSION OF SUPERCRITICAL SOLUTION (RESS), Natalia Levit and Gary Tepper, Dept. of Chemical Engineering, Va. Commonwealth Univ., Richmond, VA 23284. The phenomenal solubility of non-volatile solids in supercritical fluids (SCF) has been known for more than a century, but only recently have researchers begun to extensively develop SCF technology for materials processing. A supercritical fluid is a single phase that exhibits advantageous properties of both a gas and a liquid: viscosity and diffusivity of a gas to support mass transfer and density comparable to liquids to provide enhanced solubility. Polymer processing in SCF is a very promising area in terms of developing novel materials with unique chemical and physical properties. The high molecular weight and polydispersity of polymers provide unique challenges in materials processing. We are employing the RESS technique by means of the very rapid (in terms of microseconds) depressurization of a supercritical fluid-solute phase and precipitation of solute due to the loss of density and solvent power. A new RESS apparatus has been designed to accommodate a special reactor with a floating piston to control the solute concentration during the expansion. It is shown that by adjusting the expansion parameters, one can control the properties of polymeric surfaces. New applications including chemical sensing are proposed for precipitated polymer surfaces.

VARIATION OF SPECTRAL POWER IMMEDIATELY BEFORE SPONTANEOUS ONSET OF VENTRICULAR ARRHYTHMIAS. Venkatesh Mani, Xuejun Wu*, Peng-Wie Hsia*, Dept. of Biomedical Engg., & Mark A. Wood*, Kenneth A. Ellenbogen*, Dept. of Internal Medicine, Va. Commonwealth Univ., Richmond, Va. 23298. Short-term heart rate variability (HRV) in the frequency domain may change immediately before the onset of ventricular arrhythmias (VA). Power spectral analysis of HRV was performed using the periodogram approach on heart rate (HR) curves obtained immediately before the onset of VA and control waveforms of 78 patients (135 episodes of VA). HR curves were resampled at equal 0.5 second intervals using cubic spline fit. Total power and time course of spectral power were obtained. The spectrum was divided into 10 equal bands of 0.1Hz each. Retrospective prediction of VA was performed using a simple threshold approach. It was found that HR curves immediately before the onset VA had higher spectral power in all spectral bands than control waveforms recorded at other times ($p < 0.001$). Time course analysis showed that spectral power remained constant until 100 seconds before onset and then increased significantly in the HR curves leading to onset ($p < 0.02$). Using the simple threshold method, a predictive accuracy of $68 \pm 2\%$ could be achieved using the total power spectrum. By using specific spectral bands, the predictive accuracy could be increased to 76%. Our results suggest that a sustained higher power increase occurs during the course of 12 ± 3 minutes followed by a sudden elevation in spectral power within 100 seconds of onset of VA and may be a precursor to such episodes.

PROCESSING HIGH TEMPERATURE SOLDER JOINTS THROUGH LIQUID PHASE ENHANCED SINTERING. David A. McCall, Mark A. Palmer, Department of Mechanical Engineering, Virginia Commonwealth University, Richmond VA 23284. The modern electronics industry has long used eutectic tin-lead solder as its solder of choice. Increased pressures to limit worker and environmental exposure to lead has forced the industry to search for alternatives. However, many of these alternatives melt at temperatures significantly higher than eutectic tin-lead, and their adoption would require replacement of the existing manufacturing equipment. We propose to create solder joints by sintering. This process involves bonding particles together without melting them, solder allows the removal of lead while retaining low processing temperatures and mechanical strength. By adding small amounts of eutectic tin-bismuth powder to eutectic tin-silver solder paste, it is possible to create a joint that has a mechanical strength comparable to that of tin-lead. Sintering at 210C for 30 minutes produced joints with mechanical strength equal to or greater than tin-lead, but even when processed at 200C for 15 minutes, a workable joint was formed. While much work remains to optimize the process for the manufacturing environment, we are confident that sintering solder joints is a viable technology for surface mount assemblies.

EVALUATION OF KNEE KINEMATICS WITH A MAGNETIC TRACKING DEVICE. William B. McGarry and Jennifer S. Wayne, Dept. of Biomedical Eng., Va. Commonwealth Univ., Richmond, Va. 23298. The accurate measurement of joint kinematics is crucial to understanding, diagnosing, and assessing injuries and abnormalities. It is also critical in designing improved treatments, surgical techniques, rehabilitation tools, and prosthetic devices for pathological joints. Typically, the motion of anatomical joints is three-dimensional, which is described by six parameters or degrees of freedom. Historically, joint kinematics has been studied by radiographic and video techniques or by the use of spatial linkages. These systems are generally cumbersome in data acquisition and analysis or in physical size. Recently, magnetic tracking devices have been developed that are both easier to use and less awkward to mount and manipulate. The Polhemus 3Space[®] magnetic tracking device consists of a transmitter, up to four receivers, and the processing unit. Output from the tracking system consists of displacements and direction cosines or Euler angles. The system is being evaluated for rotational and translational accuracy and being compared to a spatial linkage system. In verifying the rotational accuracy, Euler angle data from the magnetic tracking system was compared to angular readings obtained from potentiometer voltages. An x-y grid was constructed for precise receiver positioning to validate translational accuracy. The magnetic tracking system is being compared to the spatial linkage system to evaluate its feasibility in measuring joint kinematics.

COMPUTATIONAL ISSUES IN THE REVISED SIMPLEX METHOD FOR LP PROBLEMS. D.T. Nguyen, Yu Bai, J. Qin, and Yusong Hu, Civil & Environmental Engineering Department, Old Dominion University, 135 KAUF, Norfolk VA 23529. Linear programming has long been enjoying its important role in many practical engineering applications. The basic Simplex method is first reviewed. The Revised Simplex algorithm is then discussed. Major time consuming steps of the Revised Simplex method are then identified. Different numerical strategies for efficient computations (robustness, memory and CPU time requirements, and CPU time requirements, ease of computer software implementation) are discussed and recommended. For user's convenience, options for obtaining the Minimization (Maximization) of the objective function, introducing design variable bounds, choosing different strategies for "degenerated case", saving memory/computation requirements for cases where some (or all, or none) design variables have no restriction in signs (or for cases where artificial variables are required) are all provided. Sparse computation is exploited, and explicit formula for unsymmetrical matrix inversion is used in one of the implementation strategies. To validate/test the numerical performance of our developed FORTRAN software for the Revised Simplex algorithms, several test data (ranging from 200-2,000 design variables) are solved on inexpensive SUN workstation. Numerical results have indicated that our developed software can be 7.14 to 257.14 (or more, depending on the problem sizes) times faster than the popular NUMERICAL RECIPE (FORTRAN) code.

NEW APPROACH FOR SOLVING LARGE INDEFINITE SYSTEM OF LINEAR EQUATIONS D.T. Nguyen, Gene Hou, H. Runesha, and Bangfei Han, Civil & Environmental Engineering Department, Old Dominion University, 135 KAUF, Norfolk VA 23529. Systems of sparse, symmetrical, INDEFINITE simultaneous linear equations have arisen naturally in several important engineering and science applications. Tremendous progress has been made in the past years for efficient large-scale solutions of sparse, symmetrical, definite equations. Major difficulties involved in developing efficient sparse indefinite solvers include the need for pivoting (or 2x2 pivoting), criteria for when and how to switch the row(s), effective strategies to predict and to minimize the nonzero fill-in terms etc. In our work, an alternative method is proposed for solving system of sparse, symmetrical, indefinite equations. The key idea here is first to transform the original indefinite system into a new system of symmetrical, "definite" equations. Well-documented sparse definite solvers can be conveniently used to obtain the "intermediate solution" (in the new, or "modified" system). This "intermediate" solution is then transformed back into the "original" space to obtain the "original" unknown vector.

DEVELOPMENT OF A BIOMIMICKING VASCULAR PROSTHETIC: APPARATUS DESIGN AND FEASIBILITY STUDY. Kristin J. Pawlowski & Gary L. Bowlin, Ph.D., Dept. of Biomedical Engineering, Va. Commonwealth Univ., Richmond, Va., 23298. Development of an ideal vascular replacement has been addressed with increasing urgency in recent years. To date, appropriate replacements for only medium and large diameter bypass have been realized, employing the use of Dacron and expanded polytetrafluoroethylene. Attempts at finding a solution for small diameter replacements have been met with problems such as acute thrombotic occlusion and chronic anastomotic hyperplasia. These are introduced into the grafts due to low blood flow velocities experienced by smaller caliber vessels and compliance mismatch between prosthetic and native vessel, respectively. Recent attempts at developing a small diameter vascular replacement have employed use of collagen gels as the major component; these constructs have exhibited a lack of mechanical integrity when subjected to physiological intraluminal pressures. The method proposed and described here takes the use of collagen one step further. Multiple layers of collagen thread are concentrically wound along the long axis as the main structural component and foundation upon which a vascular construct is built. Specifically, this research has been aimed at the design and construction of a device equipped to wind collagen thread at specific, reproducible orientations. The capabilities of this device in terms of possible thread spacing and angles have been determined. At this point, in conjunction with two other simple devices, this apparatus is being utilized, using 100-250 μm collagen threads, to develop vascular medial layer equivalents. This preliminary investigation is expected to prove the feasibility of this method to develop a small diameter biomimicking vascular prosthetic that has the potential to withstand physiological intraluminal pressures. (Research supported by the A.D. Williams Committee of Va. Commonwealth Univ.)

HIGH PRESSURE XENON GAMMA RADIATION SPECTROMETERS, Matthew Sherman and Gary Tepper, Dept. of Chemical Engineering, Va. Commonwealth Univ., Richmond, VA 23284. The design and performance of a two-electrode, coaxial, thermally stable gamma radiation detector is presented. Highly compressed and purified xenon is used as the detection medium. The high atomic number and large ionization energy of xenon provides excellent efficiency and thermal stability. The detector energy resolution was determined to be 4.0% for the Cesium-137 662keV line. When one factors in the effects of noise in the electronics of the system, the energy resolution is lowered to 3.2%, which places this detector's accuracy between that of a gridded xenon detector and a NaI(Tl) detector. Tests also clearly show that the detector is sensitive over a range of energies from 50keV to over 1MeV and will operate at voltages as low as 3kV. The energy resolution is also stable with temperatures up to at least 70°C and free from microphonic interference. In light of such attractive test results, this two-electrode xenon-based gamma radiation detector should be considered for a variety of field applications.

Botany

SOIL TYPE TOLERANCE IN PLANTS OF OZARK ROCK OUTCROP GLADES. Susan Crow and Stewart Ware, Dept. of Biol., Col. of William and Mary, Williamsburg, VA 23186. Shallow soils bordering rock outcrops usually support herbaceous plant species not common elsewhere. In the geologically complex Ozark region of Arkansas and Missouri, very different types of outcrops (like sandstone and limestone) occur close together. Plant species that occur on these outcrops usually either display a wide physiological tolerance or an ecotypic adaptation to substrate in order to deal with differing soil chemistry. We grew populations of six species in their native soil and an alien soil from a chemically different outcrop. *Oenothera linnifolia* Nutt. (Onagraceae) and *Hypericum gentianoides* (L.) BSP (Hypericaceae) showed strong ecotypic adaptation to their native sandstone soils. *Sedum nuttallianum* Raf. (Crassulaceae) and *Cyperus aristatus* Rottb. (Cyperaceae) showed adaptation to their native sandstone soils but some tolerance of the foreign (limestone) soil. Although *Leavenworthia uniflora* (Michx.) Britton (Brassicaceae) occurs in nature strictly on alkaline soil, there was no significant difference in growth between its native limestone and the alien sandstone soil. It may be excluded from sandstone outcrops by a strong competitor or a difference in ability to tolerate drought on different substrates in nature. Populations of *Satureja arkansana* (Nutt.) Briq. (Labiatae) from both sandstone and limestone were included in this experiment. Regardless of its native substrate, both populations grew significantly better on sandstone soil than on limestone, thus displaying neither ecotypic adaptation (in the limestone population) or broad tolerance of substrate. Some morphological differences were observable between the populations and, since the limestone population is successful in nature, presumably physiological adaptation is in progress and will continue.

PRELIMINARY STUDY OF PHYTOPLANKTON SUCCESSION IN AN OPEN POND AND A MARSHY POND. Kelly Davis*, Amanda M. Dean*, and Stephen W. Fuller, Department of Biological Sciences, Mary Washington College, Fredericksburg, Va. 22401. Phytoplankton community changes (succession) were studied in two ponds near Mary Washington College in Fredericksburg, Virginia over the Spring Semester of 1999. Water samples were analyzed for mineral nutrients and phytoplankton. Nutrient levels were found to far exceed those of other reported data. Diatoms and green algae were the predominant classes of phytoplankton observed in both ponds; however these organisms were in much lower concentration than reported in a nearby lake.

ICE STORM DAMAGE TO VIRGINIA COASTAL PLAIN FORESTS. Peter Elstner and Stewart Ware. Dept. of Biol., Col. of William and Mary, Williamsburg, Va. 23185. On December 23-25, 1998, a major ice storm struck southeastern Virginia. The storm deposited up to 2.5 cm of glaze ice on exposed surfaces, and fallen trees caused a lengthy power outage and much highway blockage. Between February and April, 1998, we recorded occurrence, severity, and type of damage for trees over 2.5 cm dbh in nine 20 x 40 m plots in Matoaka Woods at the College of William and Mary. Canopy damage varied greatly across abundant species with large trees more frequently injured than small: 75 % of large *Fagus grandifolia* were damaged in some way, while only 6 % of small *Sassafras albidum* individuals were affected. Severity of damage was slightly greater in small trees than in large; large *Pinus taeda* and small *Oxydendron arboreum* showed tendency toward severe damage, with small *Nyssa sylvatica* being entirely free of severe damage. The quantity of fallen branches in the plots was proportional to the amount and type of damage displayed by represented species. Despite severe damage to public utilities, damage within the forest was not great. Since few trees lost their entire crown, canopy gap sizes are quite small, and it is not clear that much change in forest composition is likely to result from this storm. However, increased density of ground litter will undoubtedly contribute to greater mineral release and increase the risk of fire.

A NORMAL PIGMENTED HYPOVIRULENT STRAIN OF *CRYPHONECTRIA PARASITICA* WITH DSRNA YIELDS A WHITE (EUROPEAN) HYPOVIRULENT STRAIN. G.J.Griffin, G.M.Farias*, E. Hogan*, and N. Robbins*. Department of Plant Pathology, Physiology and Weed Science, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061. In 1982 and 1983, natural blight cankers on the main stems of grafted American chestnut trees were inoculated with a mixture of dsRNA-containing, white (European) and pigmented (American and European) hypovirulent strains of the chestnut blight fungus, *Cryphonectria parasitica*. Following inoculation, a pigmented strain of *C. parasitica* with normal colony morphology was isolated from a canker on one graft. This strain contained dsRNA at high concentration. When inoculated on American chestnut stump sprouts in forest clearcuts, the normal pigmented strain produced superficial cankers with a low severity index, indicating it was hypovirulent. During routine laboratory transfer, the normal pigmented strain sector to yield the white colony morphology characteristic of European hypovirulent strains. We hypothesize that two forms of the same hypovirulence agent or two hypovirulence agents (hypoviruses) exist in these two sector (colony) types. Research is underway to investigate the nature of the hypovirulence agents. (Supported by the American Chestnut Cooperators' Foundation)

WORKING WITH THE PUBLIC FOR AMERICAN CHESTNUT RESTORATION. Lucille Griffin, Executive Director, American Chestnut Cooperators' Foundation, 2667 Forest Service Road 708, Newport, VA 24128. The American Chestnut Cooperators' Foundation was organized to restore American chestnuts in our eastern forests. We share our resources with the public for this purpose. Resources include the information developed by our researchers at Virginia Tech and Concord College, West Virginia, and the produce from our breeding program: we distribute seed nuts and seedlings with potential fro blight resistance through the mails to growers who agree to report on their progress; we distribute blight-resistant scion wood at spring clinics where we teach grafting techniques. In this way 904 individuals and many groups (4-H, Scouts, schools) in 40 states participate in American chestnut restoration. We provide the means, support their projects with advice and hold the promise for blight control in established American chestnut projects which meet the guidelines of our researchers.

EFFECTS OF UNICONAZOLE ON FREE STEROL AND STERYL ESTER POOLS IN WILD-TYPE AND HMG2 TRANSFORMED TOBACCO. Vanessa D. Jones and David M. Orcutt, Dept. of Plant Pathology, Physiology, and Weed Science., Va Tech, Blacksburg, Va. 24061. The free sterol (FS) and steryl ester (SE) composition of wild-type (WT) and hmg2 transformed (T) tobacco plants were compared with respect to tissue age and treatment with the sterol inhibitor (SI), Uniconazole (UNI). It was determined that FS and SE levels increased with leaf age in WT tobacco while T plants levels of FS declined and SE increased. The ratio of SE/FS increased with leaf age, especially in young leaves of WT plants which were found to contain twice as much SE to FS versus T plants. When WT and T plant were treated with UNI both FS and SE levels declined with leaf age. The ratio of SE/FS declined with increasing leaf age in both WT and T UNI treated plants, which is in contrast to what occurred in both WT and T control plants. Also, the ratio of SE/FS was lower in all leaves of UNI treated WT plants compared to untreated Wt controls. The same was true for UNI treated T plants - except for the youngest leaves which showed no difference. The possible significance of changes in SE/FS ratios, as well as qualitative differences in sterol composition will be discussed relative to changing membrane permeability characteristics.

THE PHYSICAL, CHEMICAL, AND BIOLOGIC PARAMETERS EFFECTING PHYTOPLANKTON ASSEMBLAGES IN FIVE EPHEMERAL PONDS IN YORK COUNTY, VIRGINIA. Michelle R. Kokolis, Dept. of Biol., Old Dominion Univ., Norfolk, VA. 23529. The Grafton Ponds Natural Area is a 374 acre preserve in York County, Virginia, approximately 14 miles north of the City of Newport News. The preserve contains over 40 ephemeral ponds. These ponds which are filled seasonally by precipitation and groundwater discharge, are typically wet from late fall through late spring or early summer. Pond size varies from 0.1 ha to 2 ha, and depths range from 4 cm to 3 meters. This study has two objectives 1) to examine the physical and chemical characteristics of five of these ponds, including pond size and depth, canopy openness, inundation period, pH, water temperature, and phosphate and ammonium concentrations 2) to examine the phytoplankton assemblages within these ponds, correlating differences in populations to the physical and chemical characteristics of each pond. This portion of the study, which is currently underway, involves the monthly collection of whole water grab samples for plankton analysis using a modified Uterhöhl method.

A PRELIMINARY STUDY OF PHYTOPLANKTON SUCCESSION IN AN OPEN POND AND A SHADED POND. Stephanie Lester*, Kerry Layne*, and Stephen W. Fuller, Department of Biological Sciences, Mary Washington College, Fredericksburg, Va. 22401. Phytoplankton succession was studied in relation to several environmental parameters in two ponds: in a large open (1) and a smaller, more shaded (2) pond located in Fredericksburg, Virginia. Water samples from each pond were collected biweekly from late January to mid-April. For each sample, the phytoplankton present were identified and counted using Sedgewick-Rafter cells. Concentrations of total nitrogen, nitrate, ortho-phosphate, and silica were determined. While other Classes were also present, the Bacillariophyceae and the Chlorophyceae were dominant in both ponds throughout most of the study. The phytoplankton population was larger in pond 1 than in pond 2, although the chemical compositions appeared much the same. This preliminary evaluation of the ponds revealed what seem to be differences in phytoplankton succession.

THE IDENTIFICATION OF LONG TERM TRENDS WITHIN PHYTOPLANKTON POPULATIONS AND WATER QUALITY PARAMETERS IN VIRGINIA RIVERS. Harold G. Marshall and Michael Lane. Dept. Biological Sci., Old Dominion Univ., Norfolk, Va. 23529-0266. A statistical analysis of phytoplankton composition, abundance and water quality over a 11 year period (Jan. 1986-Dec.1997) was conducted on the James, York, and Rappahannock Rivers. The existing plankton flora is dominated by a favorable composition of diatoms and chlorophytes, providing a primary food and oxygen source. Floral trends are mainly favorable, however, several bloom producing species show increased concentrations in several river sections. Cyanobacteria are not dominant, with cryptomonads common. There are mixed trends among nutrients within the rivers, showing decreasing trends (TN, DIN, TP, DIP) in the James, with increased trends in DIN and TP in the Rappahannock, with TN and DIN decreasing and DIP increasing in the York. The York also has mixed patterns among the phytoplankton with an increase in bloom producing dinoflagellates downstream. TSS levels appear a factor upstream in reducing floral development, with this influence decreasing downstream. The intrusion of estuarine species upstream in sub-pycnocline waters occurs and brings additional diversity to these less saline regions, with the freshwater species dominating the upstream tidal waters above the pycnocline. Supported by Virginia Dept. of Environmental Quality.

PHYTOPLANKTON DYNAMICS IN CHESAPEAKE BAY. Cara Muscio, J. Wolny, M. Kokolis, D. Seaborn, and H. Marshall. Dept. Biological Sci., Old Dominion Univ., Norfolk, Va. 23529-0266. This progress report for the phytoplankton monitoring program in the Chesapeake Bay indicates favorable trends (past 12 years) in species composition and abundance and in water quality variables. In general, the flora is dominated by centric diatoms, and in lesser concentrations are cyanobacteria, cryptomonads, dinoflagellates, and others. Autotrophic picoplankton levels are decreasing. However, there are 13 potential toxin producing dinoflagellates (10) and diatoms (3) that are being monitored. Of these, several diatoms (*Pseudo-nitzschia* spp.) and dinoflagellates, including Pfiesteria Complex Organisms have received the most attention. Nuisance algal blooms occur frequently in the lower Bay, and generally originate in the lower reaches of the Bay's tributaries and pass into the Bay, lasting briefly. In addition the ciliate *Mesodinium rubrum* is a common bloom producer in the Bay. Supported by the Virginia Dept. of Environmental Quality.

FIELD COLLECTION OF EXPLANTS FOR AXENIC CULTURES. Michael H. Renfroe, J.T. Hitt*, and P.J. McNicholas*. Dept. of Biology, James Madison Univ., Harrisonburg, VA 22807. Field collection of living plant material presents many challenges for the establishment of axenic cultures. Field material harbors a wide variety of micro-organisms which must be removed or killed prior to introduction of the material onto a nutrient-rich culture medium. Once excised, the field-collected plant material must be kept alive and hydrated until the tissue is placed on the culture medium. Tissue samples were collected from the herbaceous species *Portulaca oleracea*, and two woody plant species, *Betula pendula* and *Corylus avellana* and were subjected to various surface sterilization techniques and/or culture on an anti-microbial medium. Leaves of *Portulaca* were able to be planted in the field on an anti-microbial medium with limited development of contamination. However field inoculation onto culture medium was always inferior to surface sterilization of explants in the laboratory. For the woody specimens, inclusion of a microbicide in a transport medium was more effective than media lacking the microbicide. Inclusion of nutrients in the field transport medium proved detrimental to the reduction of contamination in the cultures. These results indicated that different field treatments may be required for different species of plants, but that explants may be successfully collected, shipped,

"WITNESS TREES" OF THE NEW RIVER REGION IN VIRGINIA. B. Jay Stipes and Karen B. Stipes, Dept. Plant Pathol., Physiol. and Weed Sci., Virginia Tech, and Blacksburg High School, Blacksburg, VA 24060. (e-mail: treedr@vt.edu). Even though most of the old growth trees in Appalachia have been harvested or have otherwise died, a small remnant of ancient monarchs yet remains. This report constitutes the start of a survey of some living white oak (*Quercus alba*) and sycamore (*Platanus occidentalis*) that have "witnessed" historic events in the New River region, especially in Montgomery County and contiguous areas. A white oak (diameter at breast height or DBH = 64 in.) "witnessed" the abduction of Mary Draper Ingles in July, 1755. A nearby sycamore (DBH = 88.5 in.) and white oak (DBH = 64.8 in.) were living when "Smithfield" plantation was built in 1774; three Virginia governors issued from the Prestons who lived there. "Solitude" plantation, also on the Virginia Tech campus and home of Gov. John Floyd (1830-34), is within site of ancient, living oaks. A large white oak (DBH = 70 in.) still lives within site of the 18th century Barger's Fort at Blacksburg. Three ancient sycamores (DBHs = 70.7, 82.7 and 94.0 in.) and well known by the Ingles family still thrive at the Ingles homestead/ferry/inn/cemetery site on the Old Wilderness Road, on the New River at Radford. Trees at other sites (Wytheville, Foster Falls, and Christiansburg or "Hans Meadow") were also studied.

COMPARISON OF THE FREE STEROL AND STERYL ESTER PROFILES OF TWO SPECIES OF GREEN ALGAE, *CHLORELLA PYRENOIDOSA* AND *CHLORELLA KESSLERI*. Donna M. Tuckey & David M. Orcutt, Dept. of Plant Pathology, Physiology and Weed Science, VA Polytechnic Inst. & State Univ., Blacksburg, VA 24061. Non-target algae species from the family Chlorophyceae, were found to be both sensitive and tolerant to treatments of sterol-inhibiting fungicides (SIFs). *Chlorella fusca* var. *vacuolata*: (UTEX# 251) formerly identified as *C. pyrenoidosa* was shown to be SIF-sensitive while *C. kessleri*, (UTEX# 262) formerly known as *C. vulgaris* was SIF-tolerant. One possible tolerance mechanism may involve changes in the qualitative/quantitative composition of free sterol (FS) and steryl ester (SE) components, resulting in altered membrane transport. Rapid changes in the levels of free and conjugated pools of sterols in yeast have been correlated with the various phases of growth, suggesting interconversions and a possible membrane regulatory role. Using the SIF-sensitive and tolerant species, growth kinetic studies were completed in which cells were sampled at various times during the life cycle, corresponding to early, mid- and late exponential phase and also to the early, mid- and late stationary phase. Analysis of both organisms indicated qualitative and quantitative variations in the FS and SE composition throughout the life cycle. SIF-sensitive species characteristically possess Δ^7 and $\Delta^{7,22}$ sterols, while tolerant species contain Δ^5 , Δ^7 , $\Delta^{5,7}$, $\Delta^{8(9)}$, and $\Delta^{5,7,22}$, sterols. Of particular interest was the detection of SE at the onset of the stationary phase of growth and also the increase in total FS over time.

PHYTOPLANKTON POPULATIONS IN HOFFLER LAKE, PORTSMOUTH, VIRGINIA: A YEAR LONG STUDY. Jennifer L. Wolny, Department of Biological Sciences, Old Dominion University, Norfolk, VA 23529. The phytoplankton and auto-trophic picoplankton populations of Hoffler Lake, a brackish-water lake in Portsmouth, VA, were monitored from May 1997 – May 1998. Analyses of the phytoplankton community using the Utermöhl method show a dominance of Chlorophytes (61-88% of the total population) throughout the year, including a winter bloom of *Chlamydomonas snowii* (maximum concentration of 2.5×10^7 cells/L). Subdominants were Cyanophytes (10-33% of the total population) whose composition included several species of *Anabaena*, *Lyngbya*, and a fall bloom of *Microcoleus*. Diatoms, dinoflagellates, and cryptophytes played a minor role in the phytoplankton populations in Hoffler Lake. Autotrophic picoplankton were analyzed using epifluorescence. The picoplankton were broken down into 2 groups, solitary cells (*Synechococcus spp.*) and a colonial form (*Microcystis incerta*). Picoplankton concentrations were around 1.5×10^7 cells/L throughout the year with their peak occurring in the summer at 3.5×10^8 cells/L. Comparison of the phytoplankton community analyses with temperature and salinity data showed the phytoplankton responded more to changes in temperature than salinity, but salinity did have an effect on the species composition in Hoffler Lake.

Chemistry

DETERMINATION OF THE SOLID SOLUTION FOR THE La-Sr-Cu-(Pd)-O SUPERCONDUCTOR. NeNe Anadu and Gerald L. Roberts, Dept. of Chemistry, George Mason University, Fairfax, VA 22030; A metal to insulator transition, as a function of Ca-doping at the La site, was previously observed in $\text{La}_{8-x}\text{Ca}_x\text{Cu}_8\text{Ni}_y\text{O}_{20}$ compounds. Substitution of Pd at one of the Cu sites and Sr at the Ca site have resulted in materials that exhibit diamagnetic behavior. In addition, the room temperature conductivities of the mixed oxide make them suitable candidates for electrocatalysis. The compounds were characterized using powder X-ray diffraction and magnetic susceptibility. Determination of the limits of the solid solution for the $\text{La}_{8-x}\text{Sr}_x\text{Cu}_8\text{O}_{20}$ will be presented.

EQUATION-OF-STATE MEASUREMENTS ON IMIDES. K. M. Bakhshi*, R. M. Bakhshi*, and R. A. Orwoll, Dept. of Chem., Col. of William and Mary, Williamsburg, Va. 23187. The *ortho* and *para* isomers of N-(phenoxyphenyl)phthalimide were synthesized by reacting phthalic anhydride with 2- and 4-phenoxyaniline, respectively, and were purified by recrystallization. As low molecular-weight analogs of polyimides, these two ether-imide compounds were chosen as sources of equation-of-state data for understanding intermolecular interactions in high-performance polyimides. The molar volumes, V , of the two isomers and two mixtures of the isomers were measured in the liquid phase as a function of temperature using a calibrated mercury dilatometer. The *para* isomer was found to be slightly more dense (1.162 vs. 1.152 g/cm³ at 160°C) than the *ortho*, possibly a consequence of a molecular structure that is conducive to closer packing in the liquid. The coefficients of thermal expansion, $(1/V)(\partial V/\partial T)_P$, of the two isomers are the same ($6.8 \times 10^{-4} \text{ K}^{-1}$ at 160°C). The thermal pressure coefficient, $(\partial P/\partial T)_V$, of the *ortho* ether-imide was found to be 11 bar/K at 151°C. With the thermodynamic equation of state, this yields a volume dependence of the internal energy, $(\partial U/\partial V)_T$, of 480 J/cm³. The authors gratefully acknowledge funding from NASA for the studies.

INACTIVATION OF GUANINE-7-METHYLTRANSFERASE WITH N-ETHYLMALIMIDE (NEM): ESSENTIAL SULFHYDRYLS? D. J. Bautz, B. L. Simms, J. D. Huggins, E. C. Raulfs, and T. O. Sitz, Dept. of Biochemistry, Virginia Tech, Blacksburg, VA 24061. The methylation of the guanine-7-position in eucaryotic mRNA cap structure is essential for ribosome binding and translation. Earlier research from this laboratory has shown that the guanine-7-methyltransferase requires thiol-protecting compounds and can be inactivated with NEM. These data suggested that there were essential reduced cysteine residues required for catalytic activity. Are these thiols located in the region of the active site of the methyltransferase? Different substrates and products were used to determine if they could protect the enzyme from inactivation. In addition, the effect of NEM modification on the binding of RNA to the enzyme was examined. The product of the methylation reaction S-adenosylhomocysteine (SAH) was the only compound that would protect the enzyme from inactivation. NEM also reduced the binding of RNA to the enzyme by about 35%. These data suggest that one or more of the essential cysteine residues are located in the region of the S-adenosylmethionine binding domain.

OXYGEN EVOLUTION AND REDUCTION OF $\text{La}_{8-x}\text{Ca}_x\text{Cu}_6\text{Ni}_2\text{O}_{20}$ AND $\text{La}_{6.4}\text{Ca}_{1.6}\text{Cu}_8\text{Ni}_y\text{O}_{20}$. Besrat Bekele and Gerald L. Roberts, Dept. of Chemistry, George Mason University, Fairfax, VA 22030; Transition metal oxides are excellent candidate materials for the catalysis of both the oxygen evolution reaction (OER) and oxygen reduction reaction (ORR). Here, the electrocatalytic behaviors of two series of 8-8-20 oxygen deficient perovskite type compounds, $\text{La}_{8-x}\text{Ca}_x\text{Cu}_6\text{Ni}_2\text{O}_{20}$ ($1 \leq x \leq 2.2$) and $\text{La}_{6.4}\text{Ca}_{1.6}\text{Cu}_8\text{Ni}_y\text{O}_{20}$ ($1 \leq y \leq 2$) are investigated. The solid solutions, which exhibited high current density and stability, are suitable candidates for oxygen electrodes. The maximum current

COOPERATIVE LEARNING IN THE GENERAL CHEMISTRY LABORATORY AT NORFOLK STATE UNIVERSITY. S.M. Black, Department of Chemistry, Norfolk State University, 700 Park Avenue, Norfolk, VA 23504. During the last year, NSU has implemented a new General Chemistry Laboratory for science majors curriculum. The new curriculum reflects the desire of the chemistry faculty to introduce students as early as possible to research and to improve the retention of material covered in the laboratory. Fewer topics are covered in greater depth, with students working in groups to solve a given experimental problem. Written proposals, lab notebook upkeep, full individual written reports and group oral reports are required. The new lab format provides opportunities for a more whole development of the students attending these laboratory courses, all science majors. A survey has been applied to the students in the fall of 98 and spring of 99 semesters. The results reveal that students have common criticisms about the new lab format: the lack of directions seems to be too wide, the lab manual is not helpful enough, more assistance in the lab is needed, and too many requirements for a course worth just one tuition credit. On the other hand, the students agree that learning is happening in all aspects they were inquired, are thrilled about cooperative work and do enjoy the experimental aspect of the chemistry lab (Support for this project has been partially provided by NSF IL/MP DUE-9751096)

THE POTENTIAL OF NITRATE REDUCTASE IN FORENSIC STUDIES OF EXPLOSIVES AND CONTRABAND DRUGS. Michelle Brock, Edward J. Poziomek, and Stephanie A. Tebault, Department of Chemistry and Biochemistry, Old Dominion University, Norfolk, VA 23529-0126. Nitrate reductase is of current interest in field analytical methods for nitrate. Nitrate is reduced to nitrite which can then be measured in several ways. We have been interested in a commercially available nitrate reductase kit which uses a color reaction for nitrite. This takes advantage of the classical Griess reaction in which nitrous acid (from nitrite) is used to diazotize an appropriate reagent followed by a second reaction to form a dye. Since many explosives contain nitro groups, and since many contraband drugs contain nitrogen we have been interested in exploiting reaction schemes in which nitrate might be used as an indicator of the target molecules. Initial studies have involved gaining experience with the nitrate reductase and Griess reaction under different conditions.

DISTRIBUTION OF DISSOLVED PLATINUM IN THE WESTERN SOUTH AND EQUATORIAL ATLANTIC OCEAN. Matthew T. Brown, John R. Donat, and Jenny C. McNeil, Dept. of Chem. and Biochem., Old Dominion University, Norfolk, VA, 23529. Three previous studies of the vertical distributions of Pt in seawater provide conflicting results suggesting that, unlike any other element, Pt displays recycled, scavenged, and conservative behavior. The goals of this present study are to: (1) discern whether Pt truly displays all three distribution types, or some subset; and (2) provide the first data on Pt distributions for a large oceanographic region in the western South and equatorial Atlantic Ocean. These data will help establish baseline Pt concentrations in the major water masses in the Atlantic against which future anthropogenic inputs of Pt (e.g., from automobile catalytic converters) can be compared. Seawater samples were collected using state-of-the-art trace metal clean techniques during the 1996 South Atlantic Contaminant Baseline Research Expedition and analyzed by the adsorptive cathodic stripping voltammetric method of Van den Berg and Jacinto (1989). So far, preliminary data from two of the six stations sampled suggest a conservative vertical distribution, with a mean Pt concentration of 0.20 ± 0.04 pM. Analyses of vertical profiles from four additional stations and surface water samples along a transect stretching from Uruguay to Barbados are ongoing.

REACTION OF COCAINE WITH SiO₂ SURFACES. Mike Callendine, Dept. of Chemistry and Biochemistry, Old Dominion University, Norfolk, VA 23529-0126, Grazyna E. Orzechowska*, Dept. of Chemistry and Biochemistry, UCLA, Los Angeles, CA 90095-1569, and Edward J. Poziomek, Dept. of Chemistry and Biochemistry, Old Dominion University, Norfolk, VA 23529-0126. There is interest in the chemistry of cocaine on various surfaces in connection with sampling and detection of the drug. There is a need to better understand the factors governing the reaction of cocaine with surfaces containing silica. 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. The major products were methyl ecgonidine and benzoic acid though methyl ecgonine and benzoylecgonine were also found. It was interesting to find an equilibrium between methyl ecgonine and methyl ecgonidine. Injection of one or the other compound resulted in formation of some of the other.

⁷⁷SeNMR OF SELENOAMINO ACIDS. Elizabeth M. Carey & P. Pleban, Dept. Chem. & Bio-chem., Old Dominion Univ., Norfolk, VA, 23529. Selenoproteins can protect against oxidative damage from reactive oxygen species. ⁷⁷Se is NMR active and should prove a useful tool to investigate the oxidation products of Se-containing compounds. Large chemical shifts are produced by small changes in the Se environment. NMR analysis of selenomethionine, SeMet, and its reported oxidation product, SeMet monoxide, has served as a starting point for these studies. Using a Varian 400 MHz Unityplus NMR we observed the ⁷⁷Se signal of SeMet at 75 ppm (vs dimethyl selenide at 0 ppm, pD = 5, T = 18 °C, 80 μmoles SeMet). Upon addition of 40 μmole of H₂O₂, the SeMet signal at 75 ppm decreased (but did not disappear) while a peak appeared at 708 ppm. An additional 80 μmoles of H₂O₂ caused the 75 ppm SeMet peak to disappear with an increase in 708 ppm peak and a second peak at 844 ppm. The original 75 ppm SeMet peak could be regenerated by addition of 160 μmole of reduced glutathione (only the 75 ppm peak was seen in the spectrum). We tentatively identified the two oxidation products with peaks at 708 and 844 ppm as the monoxide species and an intermediate. Raman analysis indicated only the presence of the monoxide. Further studies are underway to identify the compounds which generate the ⁷⁷Se signals at 708 and 844 ppm.

Fe COMPLEXATION AND SPECIATION AND THEIR POTENTIAL RELATIONSHIP TO BROWN TIDE BLOOMS IN THE PECONIC BAYS, LONG ISLAND, NY. John Consolvo, John Donat, Dept. of Chem., ODU, Norfolk, Va. 23529. Brown tide (*Aureococcus anophagefferens*) blooms have occurred in the Peconic Bays since 1985. Fe has been hypothesized to be a trigger of these blooms. Previous researchers have reported increases in the dissolved Fe concentrations preceding these blooms, and decreases in the concentrations of Fe and dissolved organic carbon as the bloom peaks, suggesting that the bloom organisms may be using organically-complexed Fe. The goal of this research was to study the potential relationship between Fe concentrations and speciation and the occurrence of Brown Tides in the Peconic Bays. Fe complexation was measured using a competitive ligand equilibration/adsorptive cathodic stripping voltammetric (CLE/ACSV) technique. Total dissolved Fe increased from 80 to 240nM preceding the bloom. One class of Fe-complexing organic ligand was detected having a log K' of ~ 21-22. The ligand concentration preceding the bloom was 240nM, and Fe was measured to be 99.99% organically complexed. During the bloom, dissolved Fe dropped to 160nM, the Fe-complexing ligand dropped to 150nM, and organically complexed Fe decreased to 72%. After the bloom's demise, dissolved Fe dropped to 50-60nM, and organically complexed Fe ranged from 80 to 90%.

THE COMPLEXATION AND SPECIATION OF Cu IN THE WESTERN SOUTH AND EQUATORIAL ATLANTIC OCEAN. John Consolvo, John Donat, Dept. of Chem., ODU, Norfolk, Va. 23529. The complexation and speciation of Cu have been determined at three stations in the Western South and Equatorial Atlantic Ocean: the Amazon plume, the equatorial upwelling zone and an area off the coast of Uruguay at 33°S, 40°W. Total dissolved Cu was determined by graphite furnace atomic absorption spectroscopy. Complexation was measured using differential pulse anodic stripping voltammetry (DPASV) at a thin mercury film-rotating glassy carbon disk electrode (TMF-RGCDE). Two classes of organic copper-complexing ligands were detected. Initial estimates of the stronger ligand class (L_1) concentration are ~ 0.5 - 2 nM with $\log K' \sim 10.5$ - 11.5 . The concentration of the weaker ligand class (L_2) ranged from ~ 1 - 10 nM and had a conditional stability constant of ~ 8 - 9 . L_1 concentrations and conditional stability constants will be refined using a competitive ligand equilibration/adsorptive cathodic stripping voltammetric (CLE/ASCV) technique. (This work was funded by NSF grant OCE-9523124 to JRD)

SIMULATING THE WATER GAS SHIFT REACTION: SYNTHESIS IN GENERAL CHEMISTRY. J. Curling, J. Grimes*, Y. Moghimi*, and W.J. F. Hunter*, Dept. of Chemistry & Biochemistry, Old Dominion University, Norfolk, VA, 23529.

The lack of natural gas caused by trade embargoes forced South Africa to develop the process of catalytic methanation. This process produces methane from coal, one of South Africa's most abundant resources, and steam with the use of a nickel or iron catalyst. In an Honors General Chemistry Lab Course, we attempted to duplicate this process within a lab environment. With the use of common laboratory equipment we attempted to develop a feasible apparatus which would produce methane gas from coal and steam. After many trials and limited success, our results were inconclusive. The simple apparatus we developed lacked the sophistication and containment to maintain a thoroughly heated system for the initial step of the process to occur. In conclusion, we believe this process cannot occur under basic laboratory conditions.

FIRE SUPPRESSANT PROPERTIES: A STUDY IN GENERAL CHEMISTRY. M.

Divers*, L. McCarraher, K. Mullinax*, B. Wolfe* and W.J. F. Hunter*, Dept. of Chemistry & Biochemistry, Old Dominion University, Norfolk, VA, 23529. Within an Honors General Chemistry Lab Course, we attempted to determine which common household chemicals would also be effective fire suppressors. By using a model wood structure for our structure fires and a container filled with motor oil for our flammable liquids fires, we conducted trials on two of the four major classes of fires. We tried to extinguish the fires using a variety of commonly used fire suppressors as well as common household chemicals that we believed would also be effective fire suppressors. Our results indicated that the aqueous solutions of the fire suppressors were the most effective fire suppressors and had the least number of flare-ups. Our experience suggests that improvements to this process could be achieved by more uniform weather conditions.

ANALYSIS OF HAMPTON ROADS WATER SOURCES: A STUDY IN GENERAL CHEMISTRY. S. Ferhut, M. Kannarkat, A. Mahajan, N. Nunnally, and W. J. F. Hunter, Dept. of Chemistry & Biochemistry, Old Dominion University, Norfolk, VA, 23529. The fear that Mount Trashmore, a beloved landmark of the Tidewater area, might be leaking arsenic into the environment piqued our collective interest in the presence of various contaminants in everyday substances in our environment. Within the context of an Honors General Chemistry Lab Course, a procedure was formulated to test various water sources from common locations. By using a commercially prepared water test kit, we determined the varying amounts/percentages of pH, alkalinity, hardness, ammonium nitrogen, carbon dioxide, chloride, and nitrate nitrogen in collected water samples. The accepted standards, as put out by the American Waste Water Association (AWWA) and described by *Standard Methods for the Examination of Water and Waste Water*, published by American Public Health (1999), served as a guideline of comparison to our experimentally obtained percentages.

SYNTHESIS OF THE η^3 -SILA-ALLYL COMPLEX $(\eta^5\text{-C}_5\text{Me}_5)(\text{PMe}_3)\text{Ru}(\eta^3\text{-CH}_2=\text{CHSiPh}_2)$ E. W. Goldman and T. D. Tilley. Department of Chemistry, Univ. of Richmond, VA 23173, and Univ. of California at Berkeley, Berkeley, CA 94708. The synthesis of $(\eta^5\text{-C}_5\text{Me}_5)(\text{PMe}_3)\text{Ru}(\eta^3\text{-CH}_2=\text{CHSiPh}_2)$, **1**, has been accomplished by heating $(\eta^5\text{-C}_5\text{Me}_5)(\text{PMe}_3)_2\text{RuCH}_2\text{SiMe}_3$ with diphenylvinylsilane at 100°C for 4 h. If compound **1** is heated in the presence of $\text{P}(\text{CH}_3)_3$ it is converted to the η^1 complex, $(\eta^5\text{-C}_5\text{Me}_5)(\text{PMe}_3)_2\text{RuSiPh}_2(\text{CH}=\text{CH}_2)$. Compound **1** crystallizes in the monoclinic space group $\text{P}2_1/\text{C}$ with 4 formula units in the unit cell. An η^3 -complex similar to compound **1**, was obtained from trivinylsilane.

CHEMISTRY MODULES OF RICHMOND (C-MoR): NOVEL TOOLS FOR VISUALIZATION AND CONCEPT REINFORCEMENT. E. W. Goldman, R. N. Dominey, W. H. Myers, and R. P. F. Kanters, Chemistry Department, University of Richmond, Richmond, VA 23173. The C-MoR project at the University of Richmond is producing high quality computer modules to help students across the undergraduate chemistry curriculum to visualize chemical entities and chemical concepts. Currently released (on CD-ROM) modules include lecture aids, tutorials, and instrument use/laboratory techniques. (<http://www.science.richmond.edu/chem/CMoR/index.html>). Modules released and under development will be displayed, accompanied by a discussion of the principles of development and dissemination followed in the project effort.

SEPARATION OF QUEUOSINE-MODIFIED tRNA ISOACCEPTORS Christopher G. Hardy, Carrie L. Skrzynski, Rana C. Morris and Mark S. Elliott, Department of Chemistry and Biochemistry, Old Dominion University, Norfolk, VA, 23529. The nucleoside queuosine is a normal modification found in the anticodon wobble position of tRNAs coding for aspartate, asparagine, histidine and tyrosine. Human cancers including lung, ovarian, lymphomas and leukemias are dramatically undermodified with queuosine. Decreasing queuosine levels are proposed to be diagnostic for increasing metastatic potential in these cell types. The traditional method to directly measure levels of queuosine modification in individual tRNA isoacceptors is based on RPC-5 reversed phase liquid chromatography. The RPC-5 method is limited by the inability of its matrix to separate different isoacceptor families with high efficiency and it is no longer commercially available. Transfer RNA isolated from SJ 1502 (queuosine-modified) and SJ 1505 (queuosine-unmodified) strains of *E. coli* was separated into distinct fractions on a Jupiter C4 column. Aminoacylation of the purified tRNA from SJ 1502 and SJ 1505 cells identified fractions containing each of three isoacceptors (His, Tyr, Asp). Measurable differences were observed in the retention times of the queuosine-modified vs. queuosine-unmodified isoacceptors, allowing quantification of the relative amount of queuosine modification. It appears that Jupiter C4 HPLC provides a superior methodology for separation of individual tRNA species and simultaneous analysis of queuosine modification levels over the traditional RPC-5 chromatography. This method may be applied to research regarding diagnostic screening of metastatic potential in neoplastic cells based on tRNA modification levels.

A COMPARATIVE AB INITIO STUDY OF THE EFFECTS OF SUBSTITUENTS POSITION ON THE NONLINEAR OPTICAL PROPERTIES OF CYANO-METHYLENE-2-YLIDENE-1,3-DITHIOLE COMPOUNDS. B.K. Harris, and S.M. Black. Center for Materials Research, Norfolk State University, 700 Park Avenue, Norfolk, VA 23504. Organic conjugate molecules presenting electron donor and electron acceptor groups possess large second-order optical nonlinearities. The nonlinear optical responses of organic crystals depend primarily on the behavior of the molecules that make up the crystal. Therefore, by chemical modification of the crystal unit, the nonlinear optical properties of the bulk can be tailored. We propose to study the effect on the nonlinear optical properties when changing the positions of the cyano and methoxycarbonyl groups on small, methyl-substituted, dithiole heterocycle structures. Hartree-Fock method, with the 6-31G** basis set, has been used to obtain the optimized structures and the following properties: dipole moments, quadrupole moments, polarizabilities and hyperpolarizabilities. The results show that the properties are very sensitive to the position of the substituents. Comparison with published values for the hyperpolarizabilities of 2-methyl-4-nitroaniline and urea, two largely studied molecules, place the systems in this study with an intermediate value for this property. (Support for this project has been provided by DOE DE-FG01-94EW11493 and NSF CREST HRD 98-05059)

LONG CHAIN ALKYLQUINOLINE SYNTHESSES. Christopher P. Hencken and Wayne M. Stalick, Chemistry Department, George Mason University, Fairfax, VA 22030. An important current goal in chemistry is to develop a better understanding of the decomposition pathways of alternate fuel sources such as oil shale and coal. It has been estimated that nitrogen containing compounds constitute about 40% of the material found in crude shale oil and based on the GC/MS analysis of these compounds, long chain alkylquinolines along with alkylpyridines are the major constituents. In our continuing study of the pyrolyses of these compounds it became necessary to synthesize a series of alkylquinolines. For this study, the isomeric undecylquinolines were selected. Even though the 2- and 4-methylquinolines easily underwent alkylation using sodium amide in liquid ammonia, 3-methylquinoline was resistant to alkylation because of side reactions. Alternative reactions for the 3-isomer were sought, among the most promising were the Friedlander synthesis and a novel ring cyclization technique. The latter, employing a phenylketimine intermediate, should upon reaction with a base, such as sodium hydride, undergo cyclization to form a second ring with an alkyl side chain in the 3-position. The cyclization reactions and identification of the previously found side reaction products will be discussed.

THE KINETIC CHARACTERIZATION OF REVERSE TRANSCRIPTASE USING FLUORESCENT TECHNIQUES. Kevin B. Howerton, Jodi Niederschmidt and Mark S. Elliott, Department of Chemistry and Biochemistry, Old Dominion University, Norfolk, VA. 23529. Reverse Transcriptase is an RNA-directed DNA polymerase isolated from several retroviruses. It has been the primary target for anti-HIV research since the discovery of its vital role in that retroviral life cycle. The conventional method for performing kinetic characterization and inhibition studies of reverse transcriptase involves the use of radioactive nucleotide substrates for the enzyme. Although this method is effective, it is both time consuming and potentially hazardous to the researcher and the environment. In response to these concerns, we have developed a novel method for performing kinetic analysis of reverse transcriptase through the use of fluorescent dyes 4'-6-diamidino-2-phenylindole (DAPI) and pico-green (Molecular Probes, Inc). We performed steady-state kinetic analysis of the commercially available reverse transcriptases isolated from MMLV, AMV and HIV using a post reaction fluorescent staining technique. We compared these results to those obtained using the conventional incorporation of 3H-dTTP into an oligo A-aT primer-template. Binding constants and kinetic parameters determined using both methods were in close agreement for all three enzymes studied. This verifies that a post-reaction fluorometric staining technique can be used as an alternative to the conventional radiochemical method. The fluorescent method may be adapted to rapid kinetic and inhibition studies of reverse transcriptase using automated multiwell fluorescent microtiter plate readers for increased productivity in drug screening assays. (NIH/NCI, R15-CA-70974).

DETERMINATION OF PROSTATE SPECIFIC ANTIGEN USING NANOPARTICLE PROBES. Robert B. Jeffers, Brad Logan, Z. Julia Wen, and X. Nancy Xu, Dept. of Chemistry & Biochemistry, Old Dominion University, Norfolk, VA 23529. Prostate Specific Antigen (PSA) has become the most useful tumor marker for the early detection of prostate cancer. However, PSA is not cancer specific. It is evident that several molecular forms of serum PSA may play important roles for the diagnosis. Thus, the development of specific PSA immunoassays has become crucial and necessary. We are measuring the binding constant of PSA with its antibody using Electrochemiluminescence. We are also developing nanoparticle probes for PSA detection. This research may lead to the development of immunoassays for the early detection of prostate cancer.

THE MAGNETIC LIQUID: A FERROFLUID STUDY IN GENERAL CHEMISTRY J. Johnson, J. Wilkie*, C. Van Raam*, and W.J. F. Hunter*, Dept. of Chemistry & Biochemistry, Old Dominion University, Norfolk, VA, 23529. Within an Honors General Chemistry Lab Course, we attempted to create a ferrofluid. By using a known chemically balanced equation. Our results indicated that the chemical formula alone cannot be used to create a ferrofluid. This formula did not provide us with enough information to successfully make a ferrofluid with the magnetic properties that it should have. One piece of information that was not given was the amount of surfactant needed. Our experience suggests that improvements to this process could be achieved by trying different amounts of surfactant as well as different types of surfactants and less water. Also, we believe the iron was fully bound by other compounds. To have magnetic properties, the iron should be in the free, ionic state that we were not yet able to accomplish.

STUDIES ON THE SULFATION OF PHENOBARBITAL. Adnan A. Kadi, W.H. Soine, Dept. of Med. Chem., Va. Commonwealth Univ., Richmond, Va. 23298. Sulfation is a route of metabolism for xenobiotic compounds containing alcohol, phenol, and amine functional groups. Phenobarbital (PB, 5-ethyl-5-phenyl-2,4,6-pyrimidinetrione) contains a barbiturate ring which could potentially undergo N-sulfonation. This report describes attempts to synthesize the N-sulfonate of PB using a variety of commonly used sulfating reagents. The reagents we evaluated included sulfur trioxide-triethylamine complex ($\text{SO}_3\text{-NEt}_3$), sulfur trioxide-pyridine complex ($\text{SO}_3\text{-Py}$), chlorosulfonic acid (ClSO_3H), and sulfur trioxide (SO_3). No sulfonation products were detected using $\text{SO}_3\text{-NEt}_3$ or $\text{SO}_3\text{-Py}$ complexes. O-Sulfation resulted when using ClSO_3H under mild conditions, but the product was extremely unstable and could not be isolated. Aromatic ring sulfonation occurred with ClSO_3H or SO_3 . The ClSO_3H required high temperatures and relatively long reaction times. When using SO_3 aromatic ring sulfonation occurred in 1.5 hr's at room temperature. The differentiation between phenyl versus N-sulfonation was based primarily on $^1\text{H-NMR}$ spectrometry. Only the more powerful sulfonating reagents reacted with PB and no N-sulfonation products were detected. Refinement of reaction conditions may lead to the desired product.

SONOCHEMISTRY OF COCAINE. Kimberly M. Kampman, and Edward J. Poziomek, Dept. of Chemistry and Biochemistry, Old Dominion University, Norfolk, VA 23529-0126. The use of ultrasound in chemistry has found several applications such as in decomposition of hazardous waste and detection of organochlorine compounds. We were interested in examining the effect of ultrasound on contraband drugs relative to the fundamental chemistry of the drugs. It was interesting to find that cocaine freebase and cocaine hydrochloride in acetonitrile and methanol, respectively, are relatively stable to ultrasound using conventional laboratory methodology. The preliminary results did indicate that sonochemical decomposition of cocaine when noted led to the formation of methyl ecgonidine. Ion mobility spectrometry was used to screen the reaction mixtures. The investigation is continuing.

SORPTIVE BEHAVIOR OF SILICA AND ITS ENHANCEMENT WITH PHOSPHATE TREATMENT. Wing H. Leung and A. Kimaro, Dept. of Chemistry, Hampton Univ., Hampton, Va. 23668. Silica with and without phosphate treatment was used as a model sorbent to develop a simple method to modify the sorbent surface for immobilization, reduction and/or attenuation of heavy metals in aquatic environments. Results showed that pH is an important factor influencing sorption of Pb and Zn on silica as illustrated in isotherm plots and adsorption edges. The sorption affinity as depicted by Freundlich constant, K_f , increases not only with pH but also with the concentration of phosphate used during treatment. The values of Freundlich constant K_f for the sorption of Pb were 1.51, 2.40 and 3.10 at pH 6.0 for the control, and the silica treated with 0.1M and 0.3M phosphate respectively. The sorption enhancement is attributed to the formation of newly created chelating groups at the surface.

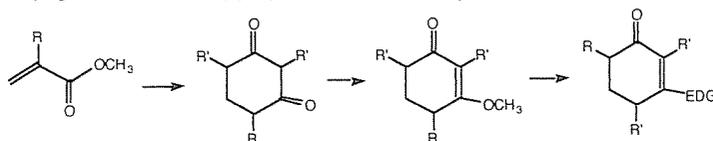
TWO-DIMENSIONAL THERMAL ANNEALING OF MIXED THIOLS ON GOLD. Daniel R. Lineberry, II, and Jack K. Steehler, Dept. of Chemistry, Roanoke Col., Salem, VA, 24153. Self-assembled monolayers (SAMs) of thiol mixtures (octadecyl mercaptan and 11-mercaptoundecanoic acid) were assembled on the surface of gold substrates. The mixed monolayers were subjected to two-dimensional thermal annealing at 90-95 °C, in a fashion analogous to three dimensional zone refining. The purpose of the annealing was to remove defects in the monolayer structure. Monolayer defects were monitored by cyclic voltammetry. Variations in the mixture ratio and in annealing conditions were studied. Annealing a 2:1 mixture of octadecyl mercaptan : 11-mercaptoundecanoic acid yielded a larger degree of defect removal than was found for 5:1 or 10:1 ratios. The optimum number of annealing passes was found to be twenty to thirty. Monolayer removal was noted at annealing temperatures higher than 95 °C or at extreme applied potentials during voltammetry. (Supported by the Roanoke College Faculty Scholar Program.)

OXIDATION OF PRIMARY AND SECONDARY ALCOHOLS USING RUTHENIUM CATALYSTS. Christopher T. Lloyd, Gerald L. Roberts, Dept. of Chem., George Mason University, Fairfax, VA 22030. In our attempt to develop a novel synthetic method for the oxidation of primary and secondary alcohols in an "atom economical" reaction, we employed the use of a variety of ruthenium catalysts. Hydrogen peroxide used as the ultimate oxidant yields water as the only by-product. The synthesis, characterization, and optimization of the reaction conditions for a variety of organic substrates are discussed. The ruthenium catalyst is easily recycled leaving no hazardous waste to be disposed, thus more appealing to industrial processes.

THE IQ OF tRNA: REGULATION OF TRANSLATION AND CELL GROWTH BY MODIFIED NUCLEOSIDES. Rana C. Morris and Mark S. Elliott. Old Dominion University, Department of Chemistry and Biochemistry, Norfolk, VA. 23529. Inosine (I) and queuosine (Q) are two modified nucleosides found in the anticodon Wobble position of several important tRNAs. I is formed by the deamination of adenosine, while Q is formed by a base-for-base exchange reaction replacing a guanine. The tRNA's anticodon is an important region whose function is to bind to and decode the mRNA's codon. Transfer RNAs modified with I or Q are proposed to alter association rates for these molecules with the codon of mRNA, which in turn adjust the rate of protein translation. Inosine has long been known as a nucleoside that is able to basepair with several partners (adenosine, cytosine, uridine and occasionally guanosine), this is due to its ability to undergo tautomerization of key hydrogen-bonding groups. In contrast, adenosine can only basepair with its Watson-Crick partner uridine. Thus, inosine has the potential to increase the rate of tRNA association with codons due to its ability to read a larger number of codons. Queuosine is a structurally restrictive nucleoside that decreases the flexibility of the anticodon loop, while loops containing guanosine can better adapt to strong basepairing with a bias for cytosine over uridine. The loss of the ability to deaminate adenosine to form I has been suggested to decrease the viability of fast growing immune cells that are lost in such diseases as immunodeficiencies. The progressive loss of the ability to form the queuosine modification is suggested to increase the rate of synthesis of oncoproteins by a codon bias directed mechanism, thereby increasing the growth rates and metastatic character of many solid and soluble tumors.

HEAVY METAL UPTAKE BY BIOSOLIDS: INVESTIGATION OF ATTENDANT MECHANISMS Nixon O. Mwebi and Isai T. Urasa. Department of Chemistry, Hampton University, VA 23668. Studies conducted with composted sludge have shown that this material has a high affinity for metals. This metal uptake property appears to be particularly pronounced for lead, for which the material showed a retention capacity of 15 % of its weight. The metal uptake process is accompanied by the release of an equivalent amount of calcium. This study will discuss the various mechanisms involved in the metal uptake process.

A GENERAL ROUTE TO THE ELECTRON-DONATING SEGMENT OF CONFIGURATIONALLY LOCKED ORGANIC NON-LINEAR OPTICAL CHROMOPHORES. Godson C. Nwokogu and Samuel Simpson, Department of Chemistry, Hampton University, Hampton, VA 23668. Anisotropic properties of small molecules are the basis of various physical phenomena that can be exploited in current and future advanced technological devices. One such property is the polarization of chromophores with a Donor-Polyene-Acceptor motif. Such molecules, under the oscillating electric field of laser light, give rise to non-linear optical phenomena whose magnitudes depend on structural aspects of the chromophore. The use of any such chromophore in a device depends on the magnitude of the phenomenon. We are interested in developing a versatile synthetic scheme that can be used to optimize various or any of the structural aspects on which the magnitude of the non-linear optical phenomenon depends. This presentation will discuss the scheme shown below which we have developed for assembling the electron-donating segment and varying the electron-donating group (EDG) of these chromophores.



INFLUENCE OF BIOSOLIDS ON METAL UPTAKE BY PLANTS. Kefa Onchoke, and Isai T. Urasa. Department of Chemistry, Hampton University, Hampton, VA 23668. A sequential extraction protocol was used to determine the fractionation and plant bioavailability of Pb, Cu, Cr, Cd, Zn, Ni, and Fe in composted wastewater sludge. A crop of rapid radish, *Raphanus sativus* L., was then grown in compost treated with Pb and Cu of different amounts. Plant tissues from pot experiments were analyzed for Pb and Cu at harvest after 6 weeks. Heavy metal concentrations in radish tissues were found to be within phytotoxic levels. While root tissue showed higher concentrations than the shoot or leaves it was observed that the amount of metal added is not taken up by the plant. This suggests that the metal uptake by the plant is from the compost. (Supported by U.S. Department of Energy, Division of Chemical Sciences)

REACTION BETWEEN CHLOROCARBON VAPORS AND SODIUM CARBONATE

J.W. Parrett, Jr.*, J.P. Sumner*, T.C. DeVore, Dept. of Chemistry, James Madison Univ., Harrisonburg, VA 22807. Since chlorocarbons tend to accumulate in the environment, there is interest in finding lower cost methods for destroying them. One possible method is to react them with an inorganic salt. The kinetics of the reactions between tetrachloromethane (CCl_4) or 1,2-dichloroethane ($\text{C}_2\text{H}_4\text{Cl}_2$) and sodium carbonate were investigated using Evolved Gas Analysis - Fourier Transform Infrared Spectroscopy. Sodium carbonate reacted with CCl_4 between 600-900 K to form carbon dioxide (CO_2) and traces of tetrachloroethene (C_2Cl_4). This reaction followed the three dimension diffusion mechanism and had an activation energy of 105 ± 10 kJ/ mol. The reaction between $\text{C}_2\text{H}_4\text{Cl}_2$ and sodium carbonate produced CO_2 , ethanal ($\text{C}_2\text{H}_4\text{O}$), water (H_2O), vinyl chloride ($\text{C}_2\text{H}_3\text{Cl}$), ethene (C_2H_4), and ethyne (C_2H_2). C_2H_4 was a principle product formed at the higher temperatures. This reaction followed the Ginstling-Brounshtein diffusion mechanism and had an activation energy of 100 ± 10 kJ/ mol.

STUDIES OF COCAINE DETECTION SENSITIVITY USING ION MOBILITY

SPECTROMETRY. Henri K. Parson, and Edward J. Poziomek, Department of Chemistry and Biochemistry, Old Dominion University, Norfolk, VA 23529-0126.

Challenges in using ion mobility spectrometry (IMS) include the possibilities of obtaining anomalous results due to factors such as the limited dynamic range of the method, masking effects by interferences, competition in the ion chemistry, decomposition of the target compounds during analysis, differences in the heat conduction and sorption properties of sample holding materials, and variations in instrument performance. Information on such factors is important to practitioners in design of test procedures. The effects are usually deleterious relative to detection of the target drug. The present study focuses on an anomaly in which IMS sensitivity to cocaine *increases* in the presence of decomposition products of cocaine. The effect of two known decomposition products of cocaine, i.e., anhydroecgonine methyl ester (AEME) (methyl ecgonidine), and ecgonine methyl ester (EME) (methyl ecgonine), and their mixtures on the IMS sensitivity of cocaine was examined. It was found that sensitivity to cocaine increases substantially when AEME is present. This is being investigated further.

EFFECT OF PROTEINS ON THE ION MOBILITY SPECTROMETRY OF HEROIN AND MORPHINE.

Henri K. Parson, Edward J. Poziomek, Andrea A. Chambliss*, and Barbara Hargrave, Dept. of Chemistry and Biochemistry, and Dept. of Biological Sciences, Old Dominion University, Norfolk, VA 23529-0126. It has been discovered that interaction of heroin and morphine with animal tissues may significantly reduce effectiveness of detection technologies for drug interdiction. The example is based on use of ion mobility spectrometry (IMS). A Barringer IONSCAN 400 IMS was used for the research though the effect is not expected to be limited to a particular spectrometer. Tissues from various rabbit organs were dried and ground into a powder. Tissue samples (0.005g) were mixed with various amounts of heroin ranging from 1ng to 200ng. Whereas 1ng of heroin alone gives a detectable IMS peak, it was found that in mixtures with animal tissue, 200ng of heroin must be present before an IMS signal is evident. A similar effect was noted for morphine. An IMS signal for morphine mixed with 0.005g animal tissue was not evident until 8,000ng of morphine were present. The IMS signal suppression appears due to a nonspecific interaction between the tissue which decreases the volatility of the target analyte under the desorption conditions of the spectrometer.

HUMIC ACID: FRIEND OR FOE? Earl F. Patterson, Stephanie A. Tebault, and Edward J. Poziomek, Department of Chemistry and Biochemistry, Old Dominion University, Norfolk, VA 23529-0126. Humic acids are of current interest because of their potential to remove metals and organic contaminants. However, humic acids may also be sources of toxic compounds such as in chlorination of water. We have been interested in the properties and chemistry of humic acids as possible interferences in analytical methods. Humic acids are complicated structures with a variety of functional groups that may provide reaction centers in many chemical processes. Hydroxybenzoic acids and aminophenols are two groups of compounds we have examined to mimic humic acid chemistry in our studies.

AN INTERDISCIPLINARY APPROACH TO THE DEVELOPMENT OF A FIELD DETECTOR DEVICE FOR CONTRABAND DRUGS. Edward J. Poziomek, Department of Chemistry and Biochemistry, Old Dominion University, Norfolk, VA 23529-0126. An interdisciplinary approach is described using organic chemistry, physical chemistry, electrical engineering, computer engineering, system operations, human factors and safety engineering. Many sources of chemical markers for cocaine and cocaine hydrochloride were considered including specific chemical moieties in the drug molecules, impurities in illicit drug processing of coca leaves, reagents and intermediates in synthesizing cocaine, hydrolysis products, transesterification products, reduction products, pyrolysis products, and oxidation products. It was concluded that thermal desorption of cocaine freebase from surfaces and thermal dissociation of cocaine hydrochloride to cocaine freebase offered the most promising approach to cocaine detection using chemical microsensors.

CHEMISTRY OF COCAINE AND HEROIN AS A SOURCE OF CHEMICAL MARKERS. Edward J. Poziomek, Department of Chemistry and Biochemistry, Old Dominion University, Norfolk, VA 23529-0126. Both cocaine and heroin are relatively nonvolatile. Volatile compounds utilized as an indication of the possible presence of cocaine and heroin (other than the drug molecules themselves) include methyl benzoate and methyl ecgonidine (for cocaine), and acetic acid for heroin. Cocaine may undergo a transesterification reaction to give methyl benzoate. This compound is often used to train dogs for cocaine detection. Methyl ecgonidine has gained recent interest as a possible indicator of cocaine. This molecule is formed from cocaine through the elimination of benzoic acid. The characteristic odor of acetic acid has been used as an indication that heroin may be present. Hydrolysis of heroin gives acetic acid and 6-acetylmorphine (nonvolatile). However, there are other potential sources of acetic acid. At most, its detection can serve to indicate the need for more careful screening.

THE SYNTHESIS AND CHARACTERIZATION OF ISOFLAVONOID-3-OLS. Gabriel Rivera, Angela Vogel and Roy Williams, Old Dominion University Enological Research Facility, Dept. of Chemistry/Biochemistry, Old Dominion University, Norfolk, Virginia. The isoflavonoids are naturally occurring 2-phenylbenzopyran metabolites found in a variety of plants including grapes, soy and flax. These compounds have been shown to exhibit a variety of biological activities, which have been associated with the unique structural rigidity, and functionality of the isoflavonoid ring system. This paper will describe our attempts to alter the functionality at C3, in order to determine the contribution of the conjugated carbonyl group to the overall biological activity of this family of compounds. This was to be accomplished by reduction of the conjugated ketone using typical laboratory reducing agents. Unfortunately, all attempts to date to reduce the carbonyl function of the two isoflavonoids flavone, and daidzein have been unsuccessful. It would appear that the isoflavonoid carbonyl group is much more stable than originally thought.

MAGNETISM STUDIES OF 8-8-20 MIXED-METAL OXIDE COMPOUNDS .

Gerald L. Roberts and Darren S. Dale, Dept. of Chemistry, George Mason University, Fairfax, VA 22030; Layered oxide perovskite materials in the 8-8-20 structure-type as well as structurally related compounds exhibit a variety of electronic and magnetic properties. Reasonable conductivities of these mixed oxides make them potential candidates for catalysis, oxidizers and bifunctional electrodes. The insulator to metal transition as a function of doping was previously reported. The magnetic properties of a series of La-Ca-Cu-(TM)-O (TM = transition metal) have been further explored to understand the relationship between sample composition, magnetic properties, stability and eventually the effectiveness as an electrode material. Substitution of Sr for Ca and other transition metals for Ni at the Cu site has resulted in materials that are paramagnetic, antiferromagnetic and diamagnetic. The synthesis, characterization and magnetic properties will be discussed.

COMPARATIVE STUDY OF DENSITY FUNCTIONAL THEORY AND LOCALIZED MOLLER-PLESSET PERTURBATION THEORY IN THE CALCULATION OF HYPERPOLARIZABILITIES OF UREA MONOMERS AND DIMERS. V.D. Roberts and S.M. Black. Center for Materials Research, Norfolk State University, 700 Park Avenue, Norfolk, VA 23504. The advent of new computational methods, which provide the inclusion of correlation at an affordable computer demand, make it promising the application of accurate ab initio calculations to obtain properties important for nonlinear optics applications. Urea systems have been studied experimentally and theoretically, and present an excellent choice to test the ability of the new methods to yield quantitative hyperpolarizabilities. We have calculated the dipole and quadrupole moments and the polarizabilities and first hyperpolarizabilities for the urea monomer and dimer using Hartree-Fock, second-order Localized Moller-Plesset Perturbation Theory (LMP2), and gradient-corrected Density Functional Theory (GC-DFT), as implemented in the Jaguar™ suite of programs. The results are comparable to the ones found in the literature, but we encountered difficulties computing the hyperpolarizabilities by LMP2, and the DFT values varied widely when a different electric field was chosen. (Support for this project has been provided by DOE DE-FG01-94EW11493 and NSF CREST HRD 98-05059)

AB INITIO INVESTIGATION OF THE ADSORPTION OF O-METHYL-P-NITROANILINE ON THE HYDROGEN-TERMINATED Si(100) SURFACE. C. Sapp-Mobley, and S.M. Black. Center for Photonic Materials Research, Norfolk State University, 700 Park Avenue, Norfolk, VA 23504. We present the initial results of a multi-step computational research to determine the geometry and interactions when o-Methyl-p-Nitroaniline (MNA) is adsorbed on the hydrogen-terminated Si(100) surface. We intend to probe the capabilities of our electronic structure methods to accurately represent the two isolated systems. We have optimized the MNA structure using 6-31G** Hartree-Fock, and obtained several properties for this isolated molecule using four different sets of calculations, combining two basis sets and two computational methods. Preliminary results show no variation in the dipole moment with either basis set or calculation method. The quadrupole moment is strongly influenced by the basis set, but not the computational method, while the hyperpolarizabilities change with both basis set and computational method. The infinite H-Si(100) surface is being currently represented by a small cluster containing 11 silicon and 20 hydrogen atoms. This cluster was also optimized at the same level as MNA. The bond lengths, and soon the bond angles, will be compared to the ones found in the infinite crystal, so that corrections may be made to our model. (Supported by the NSF CREST grand HRD 98-05059)

ANTHOCYANINS AND FLAVONOIDS IN *SARRACENIA*. Philip Sheridan, Meadowview Biol. Research Station and Dept. of Biol. Sciences, ODU and Robert Griesbach*, Floral and Nursery Plant Research, USDA Beltsville. The flavonols quercetin and kaempferol have been identified in the genus *Sarracenia* by previous workers. We were interested in determining the anthocyanins in leaves and flowers of this genus to gain a fuller understanding of the anthocyanin and flavonoid metabolic pathway in this pitcher plant genus. We expected to find the anthocyanidins cyanidin and pelargonidin since these are the anthocyanidins generally produced from the dihydro precursors of quercetin and kaempferol. Leaf and petal tissue was extracted in acidified methanol, taken to dryness in a rotary evaporator, and redissolved in acidified methanol. Samples were then eluted on an HPLC, coeluted with standards, and finally acid hydrolyzed to determine anthocyanidin and sugar moieties. *Sarracenia* species generally only produced cyanidin in leaves and petals. Glucose and galactose were the only sugars attached to the anthocyanidins. Somewhat surprisingly, *S. purpurea* petals contained both delphinidin and cyanidin. Delphinidin represents a new anthocyanidin for the genus and offers the possibility of breeding for blue flower color in this horticulturally valuable genus. The absence of pelargonidin indicates that further work on the enzymatic processes within the *Sarracenia* anthocyanin pathway are warranted.

THE SYNTHESIS AND CHARACTERIZATION OF ISOFLAVONOID PRODRUGS. Brett Silverman and Roy L. Williams, Old Dominion University Enological Research Facility, Dept. of Chemistry/Biochemistry, Old Dominion University, Norfolk, Virginia. Prodrugs are often synthesized in order to enhance the bioavailability of certain polar drugs, which have limited accessibility to target sites. The potential biological activity of many flavanoids, isoflavonoids and stilbene components from plant sources has been questioned due to their poor lipophilicity. Diadzein and genistein are two isoflavonoids that have considerable potential as anti-oxidants and anti-cancer agents but lack the lipophilicity to reach certain target sites. Trans-resveratrol (TR) is a plant phytoalexin that has similar activity but is relatively insoluble in most lipophilic solvents. This paper will describe the synthesis and structural characterization of the acetylated analogs of these compounds.

THE DESIGN AND SYNTHESIS OF POTENTIAL CAPSAICIN ANALOGS AND ANTAGONISTS. Ann Simons, Roy L. Williams and Mark Elliott, Dept. of Chemistry/Biochemistry, Old Dominion University, Norfolk, Virginia. Capsaicin is a vanillylamide natural product found in chilli peppers, which produces the hot sensation on the tongue. Over the years, analogs of this compound have been synthesized as potential antinociceptive agents. Recently, a competitive antagonist known as capsazepine has been described in the literature. Its synthesis has served to generate considerable interest in the design and synthesis of other capsaicin antagonists that might be used to study the mechanism of capsaicin activity. This paper will describe the synthesis of a potential antagonist to capsaicin based on a novel bis-3,4(methylenedioxy)-3-aminobutane molecule. Molecular modeling of this new target compound has shown it to be quite compatible structurally with the capsazepine moiety. Plans are underway to evaluate this new compound using a strain of basal root ganglia cells, which express the capsaicin receptor as part of a Calcium channel mechanism in these cells.

EFFECT OF THE QUEUOSINE ON ANTICODON LOOP FLEXIBILITY. Carrie L. Skrzynski, Christopher G. Hardy, Rana C. Morris and Mark S. Elliott. Old Dominion University, Department of Chemistry and Biochemistry, Norfolk, VA. 23529. Queuosine is a highly modified guanosine derivative found in the wobble position (#34) of four species (aspartate, asparagine, histidine and tyrosine). Prokaryotes are able to withstand environmental stress better with queuosine modification. Eukaryotes, specifically humans, maintain a high degree of queuosine modification in cells that are slow growing, cytostatic, or terminally differentiated while those cells which are typically queuosine deficient are fast growing, undifferentiated, and neoplastically transformed. Computer modeling studies completed within this laboratory indicate the cyclopentenediol ring of the queuosine modification in tRNA^{ASP} establishes a hydrogen bonding network which decreases the flexibility of the anticodon loop in and around the wobble position. Thermal denaturing studies and nuclear magnetic spectroscopy studies utilized to characterize unmodified and queuosine-modified tRNA^{ASP} and tRNA^P anticodon stem-loop structures indicate extensive hydrogen bonding causing a reduction in loop flexibility. The thermal denaturing studies presented assess the strength of the hydrogen bonding interactions and 2D heteronuclear chemical shift correlation (HETCOR) NMR studies confirm the existence of the proposed extensive hydrogen bond interactions verifying earlier computer based molecular dynamics studies.

BDMI BASED DONOR-ACCEPTOR CHROMOPHORE ALIGNMENT STUDIES. Sam-Shajing Sun, Rakhim Rakhimov and Heidi Ries, Center for Materials Research, Norfolk State University, Norfolk, VA 23504, & Larry R. Dalton, Department of Chemistry, University of Southern California, Los Angeles, CA 90089. This paper describes the synthesis, characterization, including dipole alignment studies of organic donor-acceptor chromophores composed of an electron rich aniline donor, a conjugated vinyl-thiophene bridge unit, and a bisdicyanomethyleneindane (BDMI) moiety as an electron acceptor. BDMI is one of the strongest organic electron acceptors known. In this study, the BDMI based donor-acceptor chromophores exhibited not only large first order molecular hyperpolarizability, but also excellent chemical and thermal stability. This study reveals that, though BDMI based chromophores exhibit large molecular optical nonlinearity, due to the strong inter-molecular dipolar electro-static interactions, it is very difficult to efficiently align the BDMI based chromophore dipoles in comparison to many other widely studied weaker donor-acceptor dipole chromophores such as Disperse Red, and chromophore alignment is a critical factor to achieve materials large macroscopic nonlinear susceptibility. The study also reveals that, this intermolecular interaction can be dramatically diminished by the modification of chromophore structure. *e.g.*, derivatizing the chromophore bridge units to effectively increase the spacing between chromophores.

EFFECT OF HUMIC MATERIALS ON THE GRIESS COLOR REACTION FOR NITRITE. Stephanie A. Tebault, Earl F. Patterson, and Edward J. Poziomek, Department of Chemistry and Biochemistry, Old Dominion University, Norfolk, VA 23529-0126. We have undertaken a study of the effect of humic materials on the Griess color reaction for nitrite. This reaction is used in several analytical schemes including field methods in which water samples may contain humic substances. It has been discovered that the presence of humic acids at ppm levels cause nitrite analysis to be low. The impact differs depending on the humic acid and its concentration. In some cases, the humic acid also causes the Griess reaction dye to shift to longer wavelengths. Initial investigation of the chemistry indicates that humic acids do not diazotize under the conditions of the Griess reaction. Also, the humic acids investigated do not couple with the Griess diazonium salt intermediate. Studies on the mechanism of the interference are continuing.

ELECTROCHEMILUMINESCENCE STUDY OF THE INTERACTION OF BIOMOLECULES. Z. Julia Wen, Brad Logan, Robert B. Jeffers and X. Nancy Xu. Dept. of Chemistry & Biochemistry, Old Dominion University, Norfolk, VA 23529. Tumor cells kill the T cells by expressing Fas Ligand (FasL, a cell surface protein) and binding with Fas (T cell receptor). When FasL binds to Fas, Fas triggers the sequence events that cause T cell apoptosis. In our experiments, we determined the binding constants and binding ratio of Fas-FasL using electrochemiluminescence. This study aims to the development of ultrasensitive and high selective biosensors to trigger ligand-receptor interaction on T cell surface and measure the cascade of biological events within T cell associated with such ligand-receptor interaction. Prostate specific antigen (PSA) is the most useful tumor marker for the early detection of prostate cancer, and several molecular forms of PSA are proven to be value for the diagnosis of prostate cancer. We are measuring the binding constant of PSA with antibody using electrochemiluminescence to develop specific PSA immunassays. This study aims to the development of ultrasensitive biosensors for the earlier diagnosis of prostate cancer.

ULTRASENSITIVE ANALYSIS OF HIV RECEPTORS AND NEUTRALIZING ANTIBODY USING ELECTROCHEMILUMINESCENCE Zhaoyang Julia Wen and X. Nancy Xu, Dept. of Chemistry & Biochemistry, ODU., Norfolk, VA. 23529. At the first stage of HIV-1 infection, virus attachment to the host involves the interaction of the HIV envelope glycoproteins gp120 with T cell receptor (CD4). This interaction plays a crucial role in the initial step of HIV infection. Chemokine receptors are also involved in the HIV infection. Neutralizing antibodies can be used in HIV vaccine and therapy by blocking the interaction between gp120 and CD4 or chemokine receptors. For the first time, we determined these biomolecules at the femtomole level using electrochemiluminescence (ECL). The binding constant of gp120 with CD4, neutralizing antibody and coreceptors were measured using ECL. This study may lead to identification of potential neutralizing antibodies for HIV therapy and the development of the novel ultrasensitive means for the earlier diagnosis of HIV.

THE TORTOISE BEETLE: WHERE CHEMISTRY MEETS BIOLOGY – A PRELIMINARY STUDY IN CHEMICAL MICRO-ANALYSIS. James P. Wightman, Dept. of Chem., Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. An unusual insect defense mechanism has been demonstrated for the tortoise beetle [*Hemisphaerota cyanea*] by Eisner at Cornell. The insect's defense against predator ants is based on the secretion of an oil to its feet. This defense then involves essentially an adhesion mechanism. Scanning electron microscopy was used to show details of the insect's feet. The contact angle of water was measured against the leaf surface on which the insect was collected. The Laplace equation was applied to estimate the work of adhesion required to separate the feet from the leaf surface with an intervening oil film. The major focus of the experimental work was to identify the oil secreted by the insect. Both infrared spectroscopy and static secondary ion mass spectroscopy (static SIMS) were used in the identification.

AN OVERVIEW OF PHYTOESTROGENIC AGENTS: THEIR OCCURRENCE, STRUCTURE AND BIOLOGICAL ACTIVITY. Roy L. Williams, Old Dominion University Enological Research Facility, Dept. of Chemistry/Biochemistry, Old Dominion University, Norfolk, Virginia. Phytoestrogens are estrogenic compounds found in plants. Examples of two major classes of phytoestrogens will be discussed, the isoflavonoids and trans-stilbenes. Both classes of compounds have been found to be present in grapes and subsequently in wine at relatively low concentrations. Both classes of compounds constitute potential positive health factors in the diet and from moderate, responsible consumption of wine. These compounds have been shown to be effective anti-oxidants in vitro and as such may serve as potential nutraceuticals against the aging process and oxidative stress. These two classes of compounds have also been shown to exhibit estrogenic activity in vivo and in vitro and recent evidence would suggest that they are effective apoptotic inducers in human certain human cancer cell lines.

ISOFLAVONOID PHYTOESTROGENS FOUND IN WINE: THEIR POTENTIAL BIOLOGICAL ACTIVITY. Roy L. Williams and Belinda Wilmer, Old Dominion University Enological Research Facility, Dept. of Chemistry/Biochemistry, Old Dominion University, Norfolk, Virginia. This laboratory has been investigating the presence and biological significance of various flavanoids and proanthocyanidins found to be present in grape seeds and wine. These compounds are now recognized as positive health factors with regard to their anti-oxidant activity. This paper will describe the identification of several isoflavonoids found to be present in wine. The identification of these isoflavonoids in wine reinforces the potential benefits of moderate, responsible wine consumption. The method of analysis of a variety of commercial wines by high-pressure liquid chromatography (HPLC) will be discussed together with a profile of these wines with regard to other phytoestrogens. The anti-oxidant activity (Total Anti-Oxidant Status) of these isoflavonoids will be compared to the flavanoids commonly associated with wines as well as several stilbene phytoestrogens found in wine.

ISOFLAVONOID PHYTOESTROGENS IN CRANBERRY JUICE AND URINARY TRACT INFECTIONS (UTI's). Roy L. Williams, Old Dominion University Enological Research Facility, Department of Chemistry/Biochemistry, Old Dominion University, Norfolk, Virginia. Consumption of cranberry juice has been linked by folk lore to the treatment and prevention of UTI's in women for decades. The ingredient responsible for this activity has not been identified to date. We have recently analyzed commercial cranberry juice by high pressure liquid chromatography (HPLC) and have identified two major isoflavonoids, genistein and daidzein. Daidzein levels range from 12-14 mg/L while genistein levels were in the 29-30 mg/L range. These isoflavonoids have been shown to induce apoptosis in a number of cancer cell lines and we wish to propose that these compounds are enhancing the natural anti-adherence and exfoliation process observed with cranberry consumption and UTI's.

SYNTHESIS AND CHARACTERIZATION OF THE COMPLEXES FORMED BY THE N(4-METHOXYPHENYL)PHTHALAMATE LIGAND WITH THE Co(II), Cu(II), and Zn(II) IONS. S. A. Williams, K. Esperdy, D.L. Polo and L. M. Vallarino, Department of Chemistry, Virginia Commonwealth University, Richmond, VA 23284-2006. This work is part of an ongoing 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. The N(4-methoxyphenyl)phthalamic acid (HANPPA), synthesized from p-anisidine and phthalic anhydride, was reacted with the metal acetates to yield compounds of the general formula $M(\text{ANPPA})_2(\text{solvent})_n$, where the solvent is water, methanol, or a combination of both. The complexes of Co(II), Ni(II) and Zn(II) had identical IR spectra and solubility patterns; on the basis of the d-d electronic spectra of the Co(II) and Ni(II) species, and of the ^1H NMR spectrum of the Zn(II) species, these complexes are assigned an octahedral coordination geometry with the ANPPA $^-$ anions acting as bidentate chelating ligands *via* the carboxylate and amide groups. The less soluble Cu(II) complex, which had a somewhat different IR spectrum, was, instead, assigned a dimeric or polymeric structure with bridging carboxylates. This was a group project of the students in the CHEM 406L class of 1999.

BUILDING A BETTER ANTACID IN GENERAL CHEMISTRY. S. Winchester, T. Welsh*, and W.J.F. Hunter*, Dept. of Chemistry & Biochemistry, Old Dominion University, Norfolk, VA, 23529. Within an Honors General Chemistry Lab Course, we attempted to determine if we as college students could make an antacid that would be comparable to the antacids on the market. By creating an atmosphere of the stomach using 0.50M HCl and testing different hydroxides to see which reacts better with the acid. Our results indicated that we raised the pH and the attempt was successful. Our experience suggests that improvements to this process could be achieved by more research as well as help from a gastrointestinal specialist.

SYNTHESIS OF 3-SUBSTITUTED INDOLES. James H. Wynne, Wayne M. Stalick, George W. Mushrush, Dept. of Chem., George Mason University, Fairfax, VA 22030. In order to identify many of the indole derivative sediments formed in jet fuels upon prolonged storage, the synthesis of long alkyl chain 3-substituted indoles proved necessary. Synthetic attempts were made by reacting indole under Vilsmeier-Haack conditions followed by condensation with long alkyl chain Grignard reagents. These reactions, as well as the use of protected starting materials such as 1-magnesium and 1-silyl indoles gave unsatisfactory yields of product. Because the 3-position of indole is nucleophilic, it was discovered that long alkyl chains could be introduced there, giving high purity products, by heating indole with the corresponding alcohol in the presence of a catalytic amount of base and nickel metal, at high reaction temperatures. The water by-product, which was produced throughout the duration of the reaction, was easily monitored and removed by use of a Dean-Stark trap. This very efficient, one-step reaction yielded products that were easily purified by a simple Kugelrohr distillation apparatus.

Real-TIME MONITORING OF SINGLE BIOMOLECULES USING LASER-INDUCED NATIVE FLUORESCENCE MICROSCOPY, X. Nancy Xu, Jinsong Gao and Zhaoyang Wen, Dept. of Chemistry & Biochemistry, Old Dominion University, Norfolk, VA 23529.

Biochemical analyses at the single-molecule level present unique opportunities to study and characterize the chemical and physical properties of individual biomolecules and tracking biological reactions. Rare molecules, once hidden from view by an overwhelming ensemble average, can now be singled out and explored in detail. Potential applications in biomedical research that are unique to single-molecule analysis include tracking of individual steps in a sequence of biological events, early diagnosis of diseases, monitoring of the variability of biomolecular conformations and manipulating of individual biological reactions. These same capabilities are capitalized on to lay bare the dynamics of single neurotransmitter molecules (e.g., serotonin), mechanism of T cell apoptosis, HIV infection and antibiotics

Computer Science

EXTENSION OF A BOND FLUCTUATION MODEL TO VARIOUS MOLECULAR WEIGHTS OF A PHENYLETHYNYL TERMINATED POLYIMIDE. Lawrence R. Daley, Andre Perry*, Alec White*, Dept. of Computer Science, Hampton Univ., Hampton, VA 23668, Jeffrey A Hinkley*, NASA Langley Research Center, Hampton VA 23681. One objective of the computational materials program at NASA is to use advanced computational tools to design optimum polymeric matrix composites by developing mathematical models that describe the polymer synthesis process. The bond fluctuation model puts polymer segments on a lattice, and allows randomly chosen segments to jump to nearby lattice sites after assuring that the new site is unoccupied, and that criteria for new bond lengths and angles and, in the case of polymerization and cross-linking, reactivity are met. Such a model was implemented for a phenylethynyl-terminated polyimide in a computer program written in compiled BASIC. The program's strongest feature is the use of segment descriptors which describe any given segment's functionality, lattice coordinates, and to which other segments it is bonded. The present work extends the model in several important ways. Refinements of the model show increasing average square end-to-end distances at decreasing temperatures. Future work will adjust the Boltzmann distribution parameters so that the end-to-end distances correspond with experimental values.

SIMULATED SKIN IN COMPUTER GRAPHICS. Matthew Jondrow and Jennifer Polack, Dept. of Computer Science, Mary Washington College, Fredericksburg, Va. 22401. For centuries artists have struggled to represent the human form. People have an easier time discerning flaws in visual representations of humans than any other object. Therefore this research examines one of the more sought after and complex aspects of computer graphics, approximating human form. The research attempts to model skin, underlying muscles, and bone structure on a human arm. Two methods are implemented, examined, and contrasted towards this goal. One of these methods focuses on using Bézier surfaces to create a flexible "skin" surface that remains continuous as the points are moved. The nature of Bézier surfaces allow the simulation of muscle inflation under the skin through the movement of the proper control points. The second method, detailed by Wilhelms, approximates the actual objects under the skin (such as muscles and bone) and fits skin over these objects. The underlying objects are made using different sizes and shapes of ellipsoids. The skin is created by filtering the voxelized ellipsoids, smoothing it into a continuous surface. The advantages and disadvantages of these two methods are examined.

STUDYING RADIOSITY IN A 3D-WORLD. A. Kiedlsing* and JA Polack-Wahl, Computer Science Department, Mary Washington College, Fredericksburg, VA 22401. Radiosity produces photo-realistic three-dimensional graphic images. The incorporation of radiosity into a three-dimensional renderer made possible the construction of a virtual three-room building with physically realistic Lambertian lighting and surface reflection. The three rooms created are a hallway with a sword penetrated cube sculpture and different types of light sources, a spaceship room depicting a still-life spaceship battle, and a room with a large sword and sword-shaped light sources. These three rooms show different lighting techniques of radiosity through different styles of light sources. The inter-reflection of light between the objects in each room creates unique photo-realistic gradations of light and shadowing on the objects. Modeling and rendering these rooms allowed the production of a walkthrough of images through the building. The objects within each of the rooms have ideally diffuse surfaces, or Lambertian surfaces, which reflect light equally in all directions. Similarly, light source objects are Lambertian emitters that emit light equally in all directions. These are necessary to produce the radiosity calculations of a field of light within a scene. This field of light produces physically accurate global illumination effects such as the inter-reflection of light between surfaces, soft edge shadowing, gradations of light, and color bleeding.

AN OVERVIEW OF TCP/IP. Christopher J. Pryor, Dept. of Computer Science, Mary Washington College, Fredericksburg, VA. The fundamental concept behind internetworking today is protocol layering. Much like the packaging concepts found in high level, object-oriented programming languages, the principles behind the layering scheme divide the many issues that face inter-computer communication into manageable components. Central to the Internet are Transmission Control Protocol (TCP) and Internet Protocol (IP.) Together they provide a standard interface for applications and a uniform method for using any network hardware. This has created an environment that is conducive to both troubleshooting and development. This extremely cost-effective technology has led to today's widespread use of the Internet and its technology.

Education

DESIGNING AN INSERVICE INSTITUTE ON TEACHING GEOLOGICAL AND BIOLOGICAL CHANGE AND THE NATURE OF SCIENCE FOR MIDDLE AND HIGH SCHOOL TEACHERS. Michael L. Bentley, George Glasson, and Dennis Casey, Dept. of Teaching and Learning, Va. Polytechnic Inst. & Sate Univ., Blacksburg, VA 24061. With support from the State Council of Higher Education of Virginia through the Dwight D. Eisenhower Mathematics and Science Education Program, Virginia Tech's Science Education program, in cooperation with the Virginia Museum of Natural History, the Virginia Association of Science Teachers, and several school districts, has developed *Teaching Geological and Biological Change and the Nature of Science in the Middle and High School* as a summer institute for middle and high school life science, earth science, and biology teachers. The Institute addresses often neglected content regarding evolution and the nature of science, as specified in the Virginia Standards of Learning and the National Science Education Standards. Leading scientists in the fields of cosmology, paleontology, historical geology, and evolutionary genetics will inform participants of current ideas and methods in their fields. All participants will collaborate in creating a web forum and in designing an web site to serve other Virginia teachers in these content areas.

BIOETHICS 2000: BIOETHICS PROGRAMS AT SCIENCE MUSEUM OF VIRGINIA. Eugene G. Maurakis, Science Museum of Virginia, 2500 W. Broad St., Richmond, VA 23220. Program goals of Bioethics 2000 are to stimulate and promote understanding of bioethical issues surrounding organ donation and transplantation, and the implications of genetic research derived from the Human Genome Project. Objectives of the two year program include creation of the Bioethics 2000 web site (www.smv.mus.va.us/B2000home.html); scripting, performing, videotaping a play on bioethical issues and dilemmas in organ transplantation; creating a teacher guide to accompany the play; and hosting teacher workshops, lecture series, and panel discussions in genetics and organ transplantation. Bioethics 2000 is a collaborative project with University of Richmond, United Network for Organ Sharing, Virginia Commonwealth University, Southern California Organ Procurement Center, Virginia Transplant Council, and Mills Godwin High School. Programs are funded by The Greenwall Foundation and endorsed by the National Bioethics Advisory Commission.

Environmental Science

FREE-LIVING PATHOGENIC AMOEBAE AND BACTERIA IN WATER AND SEDIMENT AT THE JAMES RIVER FALL LINE. Chris Barnard, Matthew Ettinger, Bonnie Brown, Steve McIninch*, Greg Garman*, & Stanley R. Webb, Center for Environ. Studies & Dept. of Biol., VA Commonwealth Univ., Richmond, VA 23284. The James River near Richmond is occasionally impacted by discharges from more than 40 combined sewer outflows (CSOs). These events often release large numbers of coliform bacteria, a food source for amphizoic amoebae, directly into the water column. In 1998 a broad temporal and spatial survey was conducted to determine a baseline community for amphizoic amoebae in this region. Sampling involved bimonthly collection at 30 sites from the top of the fall line to downstream tidal reaches and included recording of water quality data and levels of fecal coliform bacteria. Amoebae representing species from the taxa *Naegleria*, *Acanthamoeba*, *Vahlkampfia*, and *Vannella* were isolated from both water and sediment. *Hartmannella* was absent in the water column but was found in sediment. This area of the river represents a unique aquatic environment well suited to the growth of amphizoic amoebae, some of which represent opportunistic pathogens of both humans and aquatic animals. (Supported by the Virginia Department of Environmental Quality).

EFFECTS OF SUBURBAN AND COMMERCIAL DEVELOPMENT ON SMALL STREAM ECOLOGY IN SPEOTSYLVANIA COUNTY, VA. Michael L. Bass, Department of Environmental Science and Geology, Mary Washington College. Spotsylvania County has experienced a rapid population growth over the past ten years. New subdivision and commercial development has resulted in increased non-point source pollution of small streams with nutrients and sediment. A comparison of the macrobenthic community between a rural stream and a stream in a fast developing area showed a dramatic reduction in the diversity of the macrobenthos in the development impacted stream. This stream had an Izzak Walton League of America Save Our Streams survey score of fair to poor flowing downstream, while the rural stream scored excellent to good. Stormwater events resulted in rapid water level rise and fall as well as large silt deposition in the streambed as compared with the rural stream. Rise in nitrate, phosphate, TSS, TDS were closely related to storm events and season. Monitoring of water quality and macrobenthic community is continuing. Data from this project increases the data set for the Rappahannock River Basin.

SHADE RESPONSE OF *CHAMAECYPARIS THYOIDES*: IMPLICATIONS FOR REESTABLISHMENT. R.T. Belcher, G.J. Whiting, and R.B. Atkinson, Dept. of Biology, Chemistry, and Environmental Science, Christopher Newport Univ., Newport News, VA 23606. *Chamaecyparis thyoides* (L.) B.S.P. regeneration and restoration projects have been largely unsuccessful. Shading produced by logging slash or competition has been recognized as an important factor in cedar growth and survival. However, there is no consensus regarding light requirements of *C. thyoides*. In this study, 60 two-year-old bare root *C. thyoides* cuttings were grown in peat filled mesocosms under six different shade treatments. The treatments consisted of 45, 37, 27, 15, and 5 percent of full sun and a control (full sun). Individual tree height and basal diameter were recorded monthly, April through November 1998. Above and below ground biomass, leaf area and leaf volume were measured at the end of the growing season. One-way analysis of variance, Kruskal-Wallis one-way analysis of variance on ranks and Tukey test for pairwise multiple comparison was used. Growth impairments ($\alpha < 0.05$) were identified between the control and 27, 15, and 5 percent sun for all parameters, except basal diameter which was effected at $\leq 37\%$ sun. Cedar survivorship throughout this study exceeded 98%; however low growth rates at or below 27% reduce chances for competitive success.

INVESTIGATIONS INTO THE IMMUNE RESPONSE OF TICKS, DERMACENTOR VARIABILIS, TO CHALLENGE WITH ESCHERICHIA COLI. Shane M. Ceraul, Robert Johns, Daniel E. Sonenshine and Wayne Hynes, Department of Biological Sciences, Old Dominion University, Norfolk, Va. 23529. Ticks, like other metazoan creatures, utilize an immune response that enables the tick to control invading foreign substances. These responses may include cell mediated events such as phagocytosis, encapsulation and or aggregative events (Kerkut and Gilbert, 1985). Once challenged with Bacillus subtilis or Borrelia burgdorferi, Johns et. al. observe an increase in hemocyte numbers as well as total hemolymph protein concentration in Dermacentor variabilis. Evidence of an immune response has been established, but an in-depth morphological study has not yet been undertaken. Therefore, a morphological study using electron microscopy to determine the nature of a cell mediated immune response is proposed.

VEGETATIVE BIOMASS ACROSS A CHRONO-SEQUENCE OF CHAMAECYPARIS THYOIDES (L.)B.S.P.: PRELIMINARY RESULTS. Jeffrey W. DeBerry, Robert T. Belcher, Darren T. Loomis, Kristen M. Shacochis and Robert B. Atkinson. Dept. of Biology, Chemistry and Environmental Science, Christopher Newport University. Historically Chamaecyparis thyoides (L.)B.S.P., also known as Atlantic white cedar, ranged from Maine south to Florida and west to Mississippi. Due to intensive logging, fire suppression and hydrologic modification, Atlantic white cedar acreage has decreased by more than 90% in Virginia and North Carolina. The decline of Atlantic white cedar ecosystems has led to widespread interest in restoration. Aboveground biomass is a useful vegetative parameter for restoration research because it allows comparison of ecosystem structure as well as providing an estimation of carbon allocation. Sites were selected in southeastern Virginia and northeastern North Carolina to represent a chrono-sequence of Atlantic white cedar including young (< 10 yrs.), intermediate (10-35 yrs.) and mature (>35 yrs.) restoration stands. Eighty-five 0.25 m² clip plots were used to estimate standing crop biomass of young sites. A total of thirty-six 100 m² plots in the mature and intermediate sites was sampled following Oosting (1942). Average biomass for young sites was 386g/m²±256. A significant difference (P<0.01) was detected between intermediate and mature sites with average tree stratum biomass estimates of 8,678 g/m² ± 2,044 and 16,908 g/m² ± 6,753 respectively. By comparison, tree stratum biomass values were approximately 28% lower than estimates reported by Dabel and Day (1977). However, it is reasonable to suggest that these differences are due to wood density characteristics of dominant species. This data set will be integrated with several other parameters (decomposition, production etc) that are being measured to develop a carbon budget model to determine if Atlantic white cedar swamps are accumulating carbon.

FISH LESIONS WITH FREE-LIVING PATHOGENIC AMOEBAE AND BACTERIA AT THE JAMES RIVER FALL LINE. Matthew Ettinger, Christopher Barnard, Bonnie Brown, Steve McIninch*, Greg Garman*, & Stanley R. Webb, Center for Environ. Studies & Dept. of Biol., VA Commonwealth Univ., Richmond, VA 23284. In 1998 a survey was conducted to determine the incidence of fish with lesions and to identify the organisms or conditions responsible for the anomalies. Approximately 2% of fish had lesions. Affected fish included a number of freshwater species in addition to estuarine-dependent fish such as striped bass and Atlantic menhaden. Amoebae representing several taxa including Naegleria, Vahlkampfia, Acanthamoeba, Vannella, and Hartmannella were found as well as a number of unidentified isolates. Bacteria recovered from the fish were primarily common species of Aeromonas and Pseudomonas. Lesions often contained more than one type of bacteria with or without amoebae while other samples contained only amoebae. It is likely that these microbes represent common flora in this reach of the James River that under certain conditions can act as opportunistic pathogens thus contributing to outbreaks of fish disease. (Supported by the Virginia Department of Environmental Quality).

STUDY OF REDUCTION OF NON-POINT SOURCE POLLUTION BY VEGETATED RIPARIAN BUFFERS. Kurt N. Feldmann and Michael L. Bass, Department of Environmental Science and Geology, Mary Washington College. Forested riparian buffers are excellent nutrient and sediment filters when adjacent to agricultural or urban areas. A study was conducted on two, extensively buffered perennial tributaries to the Rappahannock River. The objective was to compile pre-development stream health data. Both streams were sampled for total dissolved solids, pH, nitrate and phosphate concentrations and a macrobenthic community analysis was completed on each. Phosphate and nitrate concentrations ranged from nondetectable to low. Macrobenthic communities were diversified and rated excellent to good according to the Izzak Walton League of America Save Our Streams survey. This data will serve as a baseline for comparison during and post development of this area.

SORPTION OF CADMIUM ON SILICA WITH AND WITHOUT HUMIC ACID. P. Gqamana and W.H. Leung, Department of Chemistry, Hampton University, Hampton, Virginia 23668. This research is part of a study to investigate the effect of sorbed humic acid on heavy metal sorption on minerals. Silica was chosen as the model sorbent, Cd the inorganic pollutant and humic acid (HuA) the organic surfactant. It is important to understand how certain factors such as pH and sorbed humic acid impact on the surface interaction. Results show that sorption of Cd increases with pH. Additionally, loading the silica surface with HuA enhances its sorption capabilities for Cd as the loaded amount increases. This study presents isotherms to analyze this phenomenon.

THE OCCURRENCE OF MERCURY IN AQUATIC ORGANISMS IN THE NORTH FORK HOLSTON RIVER. Laura Hainsworth and H.P. Rhoton*, Depart. of Chem., Emory & Henry College, Emory, VA, 24327. From 1950 to 1970, an estimated 100 lbs. of mercury per day were released by a chlor-alkali plant operating on the North Fork Holston River in Saltville, VA. The site is currently on the U.S. Environmental Protection Agency National Priorities List. Although the EPA continues to monitor mercury concentrations in some aquatic species, there is no current assessment of the overall ecosystem impact. In this study, a variety of aquatic organisms, including *corbicula f.* (asian clams) and crayfish were collected and analyzed for mercury. Samples were wet-digested, then analyzed by cold-vapor atomic absorption spectroscopy. The results indicate continuing mercury contamination, with the highest levels (0.5ppm) occurring in rock bass collected at Saltville. Organisms in higher trophic levels had higher mercury concentrations. None of the samples exceeded the US FDA guideline of 1ppm mercury.

COMPARISON OF BREEDING BIRDS IN VARIOUS SUCCESSIONAL SERIES OF ATLANTIC WHITE CEDAR (*Chamaecyparis thyoides*) AND MIXED HARDWOOD FORESTS. William M. Hester, U.S. Fish and Wildlife Service, Gloucester, Va. 23061, & Rob Atkinson, Dept. of Biol., Christopher Newport University, Newport News, Va. 23606. Few studies have compared the value of Atlantic white cedar and mixed hardwood forests to breeding birds. We therefore surveyed breeding birds in mature hardwood forests and early-, mid-, and late-successional stands of Atlantic white cedar. Data were collected in May and June, 1998. Study sites were located in southeastern Virginia and northeastern North Carolina, in and adjacent to Great Dismal Swamp, Alligator River, and Pocosin Lakes National Wildlife Refuges. Preliminary results indicate that breeding bird species richness was greatest in mature hardwood forests (26 and 23 species per site), followed by mature (17 and 11 species per site), intermediate (16 and 12 species per site), and early-successional (11, 10, and 7 species per site) Atlantic white cedar. Additional data analyses will be performed.

MICROBIAL DIVERSITY IN SOLAR SALTERNS: CARBON UTILIZATION PATTERNS. C. D. Litchfield, A. Irby, Dept. of Biol., George Mason Univ., Fairfax, Va. 22030, A. Oren*, T. Kis-Papo* Hebrew Univ. of Jerusalem, Israel. The microbial diversity of salt ponds in solar salterns can be indicated by carbon source utilization patterns. Solar salterns are coastal tropical and subtropical facilities where seawater is evaporated by cycling through a series of ponds to yield NaCl. Throughout the process microbes such as Bacteria, Fungi and Archaea grow and even thrive in the brines. The question of how diverse these populations are can be answered using *Biolog*TM microtiter plates. Each contains 95 different carbon sources and thus can be used to examine the metabolic capabilities of samples from the ponds. Over a five-year period sample water was taken from the Cargill Solar Salt Plant in Newark, California on the San Francisco Bay and the Israel Salt Company in Eilat, Israel were used to inoculate plates within 48 hours of collection, and the plates were incubated for up to four weeks. Ponds within salterns were compared with each other as well as ponds of similar salinity between the two different salterns. Individual wells were visually examined for color change of the indicator dye to score for carbon utilization. Data were analyzed by Cluster analyses and Principle Component Analyses. Both methods group the same two sets of samples together: The first group contains samples that are all (with one exception) from Eilat. All but one of the samples belonging to the second group are from San Francisco. Several samples did not group with any other samples. Most (85%) of the San Francisco samples were able to use many common carbon sources, while 85% of Eilat samples were not able to use a common carbon source. These results suggest that ponds belonging to different salterns have communities with different diversities, regardless of salinity characteristics. This is contrary to the assumption that similar communities exist in ponds of similar salinity in most salterns.

SMALL VERTEBRATE POPULATION DYNAMICS ACROSS A CHRONOSEQUENCE OF ATLANTIC WHITE CEDAR. *CHAMAECYPARIS THYOIDES*: PRELIMINARY RESULTS. Loomis, D., R. Belcher, J. DeBerry, and R. Atkinson. Dept. of Biology, Chemistry and Environmental Science, Christopher Newport Univ., Newport News, VA 23606 Atlantic white cedar, *Chamaecyparis thyoides* (L.) B.S.P., has been exploited for its timber since colonial times. Wetland permit conditions typically require forested wetland restoration for mitigation throughout the east coast. However, wildlife habitat services are seldom monitored. In Addition the U.S. Fish and Wildlife Service community profile for Atlantic white cedar wetlands states that information on animals in Atlantic white cedar wetlands is not quantitative. In this study eight sites in three age classes were selected. Each site was surveyed for small vertebrates using a combination of pitfall traps with drift fence arrays, coarse woody debris surveys, cover boards, Sherman live traps and visual observations. The preliminary results of the trappings were compared to the species lists from the literature and there were a total of 44 species found in the eight sites compared to the 95 species listed in the literature. Considerable herbivory on Atlantic white cedar seedlings has been detected at three of the four young sites.

NESTING SUCCESS OF THE EASTERN BLUEBIRD ON THE MARY WASHINGTON COLLEGE CAMPUS. Brendan Madigan and Michael L. Bass, Department of Environmental Science and Geology, Mary Washington College. Over the course of two years, twenty-six nest boxes were mounted at Mary Washington College in order to study the nesting success of the Eastern Bluebird on a college campus. In the spring of 1998, 3 of 7 boxes witnessed Eastern Bluebird families, with 2 of the boxes nested in twice. Combined, the five nests produced only 5 fledged young, with major fatalities resulting from Black Rat Snake predation. In the spring of 1999, many different nesting results were achieved as 17 of the 26 boxes were nested in. Included herein were six Eastern Bluebird nests, three Carolina Chickadee, three House Wrens, one Tree Swallow, one Tufted Titmouse, and numerous failed House Sparrow attempts. Of the 17 only 4 nests were successful, as the majority of nests were displaced by the aggressive territorial behavior of both House Wrens and House Sparrows. The successful nests, all of which were Eastern bluebirds, have fledged 7 young to date. Research will be continued in the spring of 2000.

MOLECULAR CHARACTERIZATION OF MUTANTS OF PIF-ASSOCIATED ALLELES OF THE MAIZE R1 LOCUS. Daniel J. Seay & W. B. Eggleston, Dept. of Biol., Va. Commonwealth Univ., Richmond, Va. 23284. Pigmentation of the maize aleurone and various other tissues is regulated by the *r1* locus which encodes a regulatory protein that binds to promoters of structural genes in the anthocyanin biosynthesis pathway to activate their expression. The *Plant Instability Factor (PIF)* transposable element has been shown to insert into the *r1* locus, disrupting anthocyanin production. One of these single-*PIF* insertion alleles, designated *r-g:Y2902*, produces yellow seeds with one to a few darkly pigmented spots of revertant tissue. These *r-g:Y2902* plants were pollinated with *R-g:8 pale*, which produces lightly pigmented or pale kernels. More darkly pigmented seeds potentially resulting from germinal reversion of *r-g:Y2902* were recovered, germinated and self-pollinated. Among the revertants were two that resulted from the insertion of additional DNA, potentially a second *PIF* element in or adjacent to the first. The objective of this work is to characterize one of these darkly pigmented, putative double-*PIF* insertion alleles and the molecular basis for a single phenotype mutation of this allele to lighter pigmentation. Restriction enzyme digestion and Southern blot analysis were used in this investigation.

VEGETATION IMPORTANCE VALUES WITHIN A CHRONOSEQUENCE OF *CHAMAECYPARIS THYOIDES*: MANAGEMENT IMPLICATIONS. K. Shacochis, R. Belcher, J. Deberry, D. Loomis, and R. Atkinson, Dept. of Biology, Chemistry, and Environmental Science, Christopher Newport Univ., Newport News, VA 23606 Atlantic white cedar (*Chamaecyparis thyoides* (L.) B.S.P) has declined greatly since European colonization, and current management efforts are attempting to restore the species. Red maple (*Acer rubrum* L.) has replaced Atlantic white cedar in many swamps. Importance values were calculated for four sites, which included two mature stands (> 35 years old) and two intermediate stands (between 10 and 35 years old) in the Great Dismal Swamp National Wildlife Refuge (GDSNWR) and Alligator River National Wildlife Refuge (ARNWR). Red maple had higher importance at the GDSNWR sites than at ARNWR sites. Red maple reached its highest importance for both age classes in the GDSNWR intermediate site. Importance values can be used to measure natural succession and regeneration success of Atlantic white cedar swamps. Atlantic white cedar may be losing its importance in cedar swamps due to its inability to outcompete hardwoods without natural perturbation. Future analyses will compare importance values to environmental parameters to determine conditions required for restoration.

METAMORPHOSIS-DEPENDENT SENSITIVITY TO ENVIRONMENTAL LEAD EXPOSURE IN *RANA CATESBEIANA*. Vonita L. Willis and James A. Wise, Dept. of Biological Sciences, Hampton Univ., Hampton, VA 23668. Exposure to lead is a continuing hazard to human health, especially to children. The lowest No Adverse Effect Concentration of lead for children is still unclear. Our laboratory is developing a risk assessment model for lead exposure using the larvae of *Rana catesbeiana*, the American Bullfrog. This model gives the investigator a unique opportunity to study lead exposure and different stages of development independent of maternal influence. Our initial chronic toxicity studies showed that tadpoles of intermediate stages of development were the most sensitive to high lead concentrations. During these assays, severe skin deterioration and eye cloudiness were observed. We also showed that lead accumulated in the bodies of the tadpoles during these assays, specifically in the skin, kidney, and liver. We propose to concentrate on tadpole skin to further investigate the effects of lead. We will examine the tadpoles skin with conventional and electron microscopy to determine the exact nature of the lead-induced damage. We will also make use of the short circuit current to investigate the effects of lead exposure on ionic transport across lead-treated tadpole skin and epithelial cell lines. Our goal is to investigate the effects of lower concentrations of lead in these assays for use in the development of our risk assessment model.

Pfiesteria piscicida Special Session

A COHORT STUDY TO DETERMINE THE EPIDEMIOLOGY OF ESTUARY ASSOCIATED SYNDROME. Lily Ingsrisawang*, Megan Turf* & Elizabeth Turf, Ph.D.*, Survey & Evaluation Research Lab., Va. Commonwealth Univ., Richmond, Va. 23284. Estuary-Associated Syndrome (EAS) is the name given to a potential illness characterized primarily by changes in an individual's cognitive abilities and possibly related to exposure to toxin produced by *Pfiesteria piscicida*. To learn more, a cohort of individuals potentially exposed to waters containing *Pfiesteria* or *Pfiesteria* complex organisms (PCOs) are being followed for up to five years to determine if exposure to *Pfiesteria*/PCOs is associated with illness. Participants undergo medical exams twice a year and provide exposure data biweekly. In association with the human health study, environmental data are being collected, examined and analyzed. Sixty-one participants have been followed for one year; currently there are 112 persons enrolled. No EAS or *Pfiesteria piscicida* was identified during 1998. Preliminary results indicate a decreased visual contrast sensitivity in persons exposed to waters on the western side of the Bay when compared to persons on waters around the Eastern Shore but more analysis is required before an explanation can be suggested. (Supported by the Ctrs for Disease Control & Prev through the Va. Dept. of Health.)

THE CONTRIBUTION OF *VIBRIO* TO *TILAPIA* MORTALITY IN *PFIESTERIA* BIOASSAYS. Brian Dyer and A.S. Gordon. Dept. of Biological Sciences, Old Dominion University, Norfolk, VA 23529-0266. Bioassay utilizing *Tilapia* as the target organism is still the "gold standard" for determining whether *Pfiesteria* strains or *Pfiesteria* complex organisms isolated from the environment are toxin producers. More sophisticated molecular and biochemical methods that are currently being developed still require validation with bioassay methods. We have established the *Tilapia* bioassay for ichthyotoxicity caused by *Pfiesteria piscicida* utilizing the protocols developed in Dr. JoAnn Burkholder's laboratory. Initial trials with *P. piscicida* resulted in fish kills when cultures from Burkholder's laboratory were utilized. However, when putative *Pfiesteria* was raised on *Rhodomonas* prey from cyst-containing sediments derived from toxic bioassay tanks, the resulting cells were non-toxic. This result may be due to non-toxic forms outcompeting toxic forms when cultures were raised on algal prey. After a fish died in our stock tanks, we isolated an amoeba that resembled *Pfiesteria* and utilized it in bioassays. This amoeba was non-toxic. A strain of *Vibrio alginolyticus* was isolated from the lesions of fish that died in our stock tank and in the control tank in the third bioassay. This bacterium produced gill and fin ulcers in *Tilapia*. Consequently it is important to monitor bacterial disease and distinguish between causative agents of fish mortality in the standard *Pfiesteria* bioassay.

INTRODUCTION:THE PFIESTERIA COMPLEX ORGANISMS. Harold G. Marshall, Dept. Biological Sci., Old Dominion Univ., Norfolk, VA 23529-0266. The dinoflagellate *Pfiesteria piscicida* and the *Pfiesteria* Complex Organisms are described in relation to their similarities in size, shape, and life cycles. Emphasis is placed on members of the Complex identified from Virginia estuaries during the 1998 monitoring program. Species were isolated, cultured and examined using scanning electron microscopy (SEM). These include a dominant *Cryptoperidiniopsis* sp., plus several other gymnodinioid species that were derived from water and sediment samples provided by personnel from the Va. Dept. of Environmental Quality (DEQ) and the Va. Shellfish Sanitation Division. These included several species that have not been identified to date, plus species within the genera *Gymnodinium*, *Amphidinium*, and *Gyrodinium*. Several of these more dominant species are in culture to identify stages of their life cycles and further SEM examination. Supported by the Va. Dept. of Health and DEQ.

MONITORING RESULTS FROM VIRGINIA WATERS FOR SPECIES WITHIN THE PFIESTERIA COMPLEX. Harold G. Marshall, David Seaborn and Jennifer Wolny. Dept. Biological Sci., Old Dominion Univ., Norfolk, VA 23529-0266. Results of several monitoring programs in Virginia waters for *Pfiesteria* Complex Organisms (PCO) are presented. From May through October 1998, 2096 water samples and representative sediment samples, from 182 sites, were examined for PCO. At least once during this period PCO occurred in water samples at 90% of these sites. During this period, 40% of the total water samples contained PCO. Cell concentrations of PCO ranged from zero to 630 cells/ml. We also derived PCO from 83% of the sediment samples taken throughout Virginia waters. *Cryptoperidiniopsis* sp. was the dominant PCO among many species, but *Pfiesteria piscicida* was not detected in 1988. The PCO are widely distributed in Virginia waters and the sediment analysis indicates they are also resident species throughout these estuaries. Supported by Va. Dept. of Health, Dept. of Environmental Quality, and EPA.

VIRGINIA'S PFIESTERIA MONITORING PROGRAM: WATER QUALITY. Roger K. Everton*, Wick T. Harlan*, Jonathan W. Priest*, Virginia Dept. of Environmental Quality, Virginia Beach, VA 23462 & Mark S. Alling*, Virginia Dept. of Environmental Quality, Glen Allen, VA 23508. During the summer and early fall of 1998, 34 estuarine stations in Virginia were sampled for *Pfiesteria* Complex Organisms (PCOs) and associated water quality conditions. Stations were sampled either bimonthly (20 stations) or monthly (14 stations) from June to October 1998. At each station, a set of live and Lugol's preserved samples were collected for presumptive counts of PCOs and water quality conditions were determined. Water quality parameters measured included standard field parameters, nutrients (total, dissolved, and particulate), chlorophyll a, and conventional water quality indicators. Although PCOs were relatively low in 1998 as compared to 1997, presumptive PCO counts revealed higher PCO levels at stations located in the Northern Neck area (Potomac Embayments, Rappahannock River, and other smaller watersheds). The water quality parameters of pH, dissolved oxygen, and temperature were correlated with higher PCO counts, while several nutrients, salinity, and turbidity were negatively correlated with PCOs.

DEVELOPMENT OF GENE PROBES TO *PFIESTERIA PISCICIDA* AND OTHER TOXIC DINOFLAGELLATES IN ESTUARINE WATERS AND ALGAL CULTURES. Parke A Rublee*. Biology Dept., Univ. NC at Greensboro, Greensboro, NC 27412. Development of molecular probes is problematic for species such as *Pfiesteria piscicida*, which cannot be grown axenically, and which may represent a group of related but previously unknown organisms. We have developed three types of gene probes to the small subunit ribosomal gene (SSU rDNA) of *Pfiesteria piscicida*, that can be used at reasonable cost and provide rapid results. Heteroduplex mobility assays (HMA) use dinoflagellate specific primers and can determine whether cultures are monoclonal or represent more than one dinoflagellate species. Two other probes, target fragment amplification by PCR and fluorescent *in situ* hybridization (FISH), are useful assays in natural water samples. We have been able to document the presence of *P. piscicida* at sites along the US east coast where its presence was previously unknown, as well as to confirm its presence at sites of fish kills and fish lesion events. Our ongoing work is directed toward: 1) development of shipboard assays which can provide quantitative results within hours; 2) expanding our capabilities to probe for additional members of the toxic *Pfiesteria*-complex; and 3) using the probes to sample at spatial and temporal scales which can provide insight into factors that trigger these toxic algal blooms.

LESIONS IN ESTUARINE FISH: MULTIFACTORIAL STRESSORS, *Pfiesteria* AND OTHER ETIOLOGIES. Andrew S. Kane*, University of Maryland, Aquatic Pathobiology Center, Department of Pathology, 10 South Pine St., Baltimore, MD 21201. Lesions in estuarine finfish are associated with a variety of organisms including parasites and bacterial, viral and fungal infectious agents. In addition, trauma, suboptimal water quality and other abiotic stress factors may result in loss of homeostasis and/or gross lesion formation. Despite the many different known causes of fish lesions, the popular press and the scientific literature have recently emphasized *Pfiesteria*-like dinoflagellates and their toxins as primary causative agents for finfish lesions, particularly mycotic granulomatous ulcers in Atlantic menhaden. While some laboratory data suggest that *Pfiesteria* may be associated with field-observed lesions, cause and effect evidence is still needed to determine the role of *Pfiesteria*-like dinoflagellates as well as other risk factors in lesion initiation and progression. This outlook will help to avoid bias and may foster a broader perspective on examining the health of estuarine systems in general.

STUDIES OF GROWTH AND FEEDING BY THE DINOFLAGELLATE *CRYPTOPERIDINIOPSIS* ON ALGAL PREY. David W. Seaborn, A. Michelle Seaborn, William M. Dunstan, and H. G. Marshall. Old Dominion University, Department of Oceanography and Department of Biological Sciences. Norfolk, Virginia. 23507. Dinoflagellates were isolated from sediment samples collected in the Virginia portion of Chesapeake Bay and its tributaries. A species of *Cryptoperidiniopsis* was commonly found. In 51 sediment samples analyzed, the dinoflagellate was found in more than half of the cases. This species appears to be separate from *C. brodyii*, found in Florida (confirmed by Dr. Karen Steidinger). The dinoflagellate was grown in f/2-Si media with *Cryptomonas* sp. (#1263 Bigelow Laboratories) as an algal food source. Growth and feeding studies were conducted using triplicate experimental samples (dinos and food) and controls (food only). Factors tested include temperature, salinity, light intensity, and food concentration. The growth rate of *Cryptoperidiniopsis* was found to be quite high when compared to other dinoflagellates. In its logarithmic growth phase the dinoflagellate can double every 8-10 hours. The maximum dinoflagellate abundance was related to increased concentration of algal prey. Effects of temperature, salinity and light will also be discussed. Funding provided by Virginia Department of Health and Department of Environmental Quality.

1998 Late Entries

PUBLIC PARTICIPATION IN ENVIRONMENTAL POLICY MAKING: CHESAPEAKE BAY AND POLICY IMPLEMENTATION. Henrietta Bullinger, Dept. of Biol., George Mason Univ., Fairfax, Va. 22030. Public participation has not only become a de facto norm in numerous environmental policy issues, it is also concomitant with democratic values. This paper examines the theoretical underpinnings of participatory theory and establishes criteria for evaluating participatory process developed from two main strands of normative theory. Drawing from both democratic and critical theory, which can broadly be described as macro and micro approaches to participatory theory, direct and meaningful participation is defined and operationalized. The Chesapeake Bay Watershed, home to over 14.9 million people and extending into 6 different States and the District of Columbia, serves as a case study for participatory mechanisms in a transboundary policy process. Participatory mechanisms are surveyed at both the local government and regional level. The Local Government Participation Initiative and the Citizens Advisory Committee are examples of participatory innovations.

INVESTIGATION OF HALOPHILIC ARCHAEA FROM INLAND SALINE LAKES IN THE PEOPLE'S REPUBLIC OF CHINA. A. L. Cardwell, Dept. Of Biology, George Mason Univ., Fairfax, Va. 22030, & C. D. Litchfield, Dept. Of Biology, George Mason Univ., Fairfax, Va. 22030. The identifications of three unknown halophilic Archaea, isolated from inland saline lakes in western China, were investigated. The three organisms, designated C3, C5, and C12, are pleomorphic non-motile rods, 0.5-4 μm in length, and 0.5-1 μm in width. They are all gram negative, catalase positive, and oxidase positive. All three hydrolyze starch. C3 grows optimally at 25% NaCl and 37°C. C5 grows optimally from 10-25% NaCl and 25-42°C. C12 grows optimally from 10-20% NaCl at 25°C. C3 requires a pH of 5.5 or greater for growth. C5 and C12 both require pH of 6 or greater for growth. All produce acid with glycerol, glucose, and several other carbohydrates. C3 has not yet been identified. C5 polar lipids, PG, PGS, PGP, S-TGD-1, S-DGD-1, and DGD-1, make *Haloferax* the most likely genus for this organism. C12 ability to produce acid in carbohydrates and its polar lipids, PG, PGS, PGP, and S-TGD-1, make *Halorubrum* the most likely genus for this organism. (Supported by a BSF Grant #9500027)

SEASONAL VARIATION IN KIDNEY-FAT INDICES OF MULE DEER FROM COLORADO. J. M. Chapman, P.F. Scanlon, and G.A. Speights. Department of Fisheries and Wildlife Sciences, V.P.I.&S.U., Blacksburg, VA 24061-0321. Fat deposits in the body indicate the condition of wild animals, particularly as condition relates to preparation for winter. A major fat deposition site is the perirenal connective tissue. The ratio of kidney weight to weight of perirenal fat has been used to develop a kidney-fat index (%KFI). Seasonal variation in kidney-fat indices among mule deer (*Odocoileus hemionus*) from Colorado were studied. The deer were collected from the US Air Force Academy, Colorado Springs, CO. Samples from throughout the year were available. There were distinct patterns in %KFI. Fawns had the lowest maximum %KFI followed by yearlings and adults. There was a significant difference in %KFI distribution between males and females ($p < 0.001$). Males showed a sharp increase in %KFI during September, but rapidly lost %KFI during the following rut. At the onset of spring, males began regaining %KFI. Females had high %KFI during the fall, dropping to moderate levels through the winter. Very low %KFI was observed in females during May and June, which corresponds with the time of parturition and the early stages of lactation.

ESTIMATING SOIL INGESTION FROM RUMEN CONTENTS AND FECAL PELLETS OF MULE DEER. Justin A. Crawford, Aaron J. M. Russell, and Patrick F. Scanlon, Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061-0321. Many wildlife species ingest considerable amounts of soil with their food. Soil thus ingested may be a source of minerals or be a route for contaminant uptake. Assessment of soil ingestion in wild species is frequently dependant on measurements from feces. Concentrations of Acid Insoluble Residue (%AIR) in feces provide a reasonable estimate of soil ingestion. Mule deer (*Odocoileus hemionus*) from the U.S. Air Force Academy grounds were used as sources of rumen contents and fecal pellets. Data were noted on age, sex, and month of harvest (November or December). AIR content of rumen contents varied from 0.3 to 4.8% of dry matter (DM); those of pellets ranged from 0.6 to 21.5% DM. Males tended to have higher mean AIR in rumen contents and feces than females. AIR content of rumen contents and pellets tended to be higher in December than in November.

MICROBIAL COMMUNITY DYNAMICS DURING THE BENCH-SCALE BIOREMEDIATION OF PETROLEUM-CONTAMINATED SOIL. Kristin Fitzgerald & Dr. Carol D. Litchfield, Dept. of Biol., George Mason Univ., Fairfax, Va. 22030. A bench-scale bioremediation of petroleum-contaminated soil was conducted in 4 bioreactors for 31 days. Over the 31 days, three bioreactors received aqueous nutrients, while a fourth (control) received only water. Samples were taken 11 times. Several methods were used to follow the dynamics of the microbial communities in the bioreactors, including GN BIOLOG plates. BIOLOG plates are 96-well microtiter plates that contain 95 wells with a unique carbon substrate and 1 control well that lacks a carbon substrate. BIOLOG plates are inoculated and when a carbon substrate is metabolized by the inoculum, an indicator dye turns purple. Following inoculation of the BIOLOG plates, results were recorded several times until the plates stabilized. Results indicated that petroleum did not carryover in sufficient amounts to produce false positives. Results also showed that the microbial communities receiving nutrients were able to metabolize the carbon substrates more quickly than the nutrient-deprived microbial communities. It was concluded that BIOLOG can be used for community analysis of petroleum-contaminated soils and can distinguish between metabolically different communities.

GC/MS ANALYSIS OF STEROLS IN THE POCOMOKE RIVER. Rashmi Ghei, K. Lauer, M. Thurmond, T. Huff, E.C. Roberts, G.D. Foster, Dept. of Chem., George Mason Univ., Fairfax, Va. 22030-4444. There have been recent outbreaks of *Pfiesteria*, a toxic dinoflagellate, that have been linked to the fish kills in the Pocomoke River. It has been found that *Pfiesteria* abundance is related to the nutrients from wastewater, urban and agricultural runoff and other sources. Steroid derivatives (sterols, stanols, stanones) contribute to this nutrient enrichment in the Pocomoke River. A sediment sample from the Pocomoke River was analyzed for steroid derivatives using Gas Chromatography-Mass Spectrometry. Qualitative and Semi-quantitative analysis was performed. Stigmast-4-ene-3-one, Cholest-4-ene-3-one, Ergost-5-en-3-ol 3[beta] and Stigmasta-5,24(28)-diene-3-ol 3[beta] were found.

ANALYSIS OF SOIL pH AT TWO ATLANTIC WHITE CEDAR (*CHAMAECYPARIS THYOIDES* (L.) B.S.P.) SITES IN SOUTHEASTERN VIRGINIA. Carter Goerger, Undergrad. Asst., D. A. Brown, Grad. Asst., and R. B. Atkinson, Ph.D., Asst. Prof., Dept. Biol., Chem. Env. Sci., Christopher Newport Univ., Newport News, Va. 23606. Atlantic white cedar (*Chamaecyparis thyoides* (L.) B.S.P.) is valued for the quality and growth form of its wood and, as a result, has been overharvested from many areas. Since the early 1800's for example, *C. thyoides* habitat in Virginia has been reduced by 90%. This species, which commonly occurs in strongly acid organic soils along a narrow coastal range from Maine south to Mississippi, has difficulty regenerating naturally after human disturbances. In this study, soil acidity (pH) was compared at a wetland restoration site and a creation site in southeastern Virginia. Soil characteristics of the restoration site in the Great Dismal Swamp (DS) contrasted greatly with those of the creation site located on an abandoned agricultural field (CG). Soil samples were taken in each of 456 plots (222 at DS and 234 at CG), using a 68.6 ml cylinder. From each air-dried soil sample, a 20 g subsample was mixed with 20 ml distilled water and read by pH meter. The organic soil pH at DS ranged from 3.4 to 5.5 with a mean of 3.9. The sandy mineral soil pH at CG ranged from 4.2 to 6.1 with a mean of 5.3. A two-tailed t-Test assuming equal variance showed a significant difference between sites at $P < 0.0001$. Such a significant difference in soil acidity may not be mitigated in the lifespan of this study, at least in terms of wetland creation. The restoration site, where pH is similar to that in successful *C. thyoides* stands, may be the environmentally preferable alternative.

RECLAMATION OF CABIN BRANCH PYRITE MINE: WATER ON THE MEND?

Claudia Hamblin-Katnik, Amy Maher*, Ann Brazinski*, and Mike Komelasky, Dept. of Biol., George Mason Univ., Fairfax, Va. 22030. In the summer of 1995, the abandoned Cabin Branch Pyrite Mine (with acid-producing tailings) was reclaimed. The site is now vegetated and the restoration phase of the project is underway. The purpose of this investigation is to monitor the long-term chemical, physical, and biological water resources to assess whether water quality and aquatic habitat improvement objectives of the restoration program (compliance with the Clean Water Act) are being obtained and sustained in Quantico Creek. Five in-stream sites were chosen where water chemistry and physical parameters, macro invertebrate, and fish samples were taken. Results to date show that pH is being maintained between 6.5-7.5. All metals have diminished substantially with the largest reductions in aluminum and iron. Each impacted site shows increases in macro invertebrate and fish taxa richness and abundance. All preliminary data indicate that the water quality is improving at this site. Further research is needed to determine if these data are representative of a long-term pattern and if wet weather flows will have a detrimental impact on stream quality. (Supported by the National Parks Service)

EVALUATING THE RELATIVE EFFECTIVENESS OF CONFLICT RESOLUTION PROCESSES:

APPLICATION TO THE BIG HORN RIVER CASE IN WYOMING. Annette P Hanada, Dept. of Biol., George Mason Univ., Fairfax, VA 22030. Bonnie G. Colby*, Dept. of Agriculture & Resource Economics, Univ. of Arizona, Tucson, Arizona, 85721., & Tamra Pearson d'Estree*, Inst. For Conflict Resolution, George Mason Univ., Fairfax, VA 22030. Water rights in the Western United States are attached to the land and have prior appropriation rights. The adjudication and administration of water rights has been left to state courts and agencies throughout the West. When the Wind River Reservation (Reservation) in Wyoming was created in 1868, the Shoshone and Arapaho tribes received federal protection from appropriation. A conflict arises therefore, between federal protection and state regulation. The Big Horn River Case serves as an example of the complexities in Western Water disputes. The conflict has been ongoing for the last 20 years and significant resources have been expended on defining who has legal authority over water rights within the Reservation. These efforts have not, however, resulted in the settlement of water right disputes in the Reservation. A theoretical framework for evaluating success in the resolution of environmental disputes will be applied to the Big Horn River Case. Five criteria that conceptualize success and effective conflict resolution, identified and summarized in a guidebook, will serve as parameter in addressing the preliminary evaluation of success in the Big Horn River water dispute.

A COMPARISON OF THE BENTHIC FORAMINIFERAN POPULATIONS OF THE

YORK RIVER AND A YORK RIVER MICROCOSM. Susan E. Hopper and Stephen B. Gough, Ph. D. Mary Washington College, Fredericksburg, VA, 22410-4666. This study examines a microcosm's ability to emulate a natural study site in the York River by comparing the foraminiferan populations of both sites. Core samples were collected from the York River site and the microcosm and preserved in 10% FAA. The meiofaunal sections were obtained by sieving the samples, which were then stained with Rose Bengal stain, dried, and specimens identified. Chi-square analysis shows that the populations of the two sites are not similar. The difference may be due to the following reasons: the microcosm may be imitating a different portion of the York River, the environmental conditions of the microcosm were altered due to system failures, and shallow-water benthic foraminiferans show an inherent spatial patchiness.

SOURCING OF SEDIMENTARY ORGANIC MATTER USING STEROID SIGNATURES. Kimberly P. Lauer, M.E. Thurmond, R. Ghei, T. Huff*, E.B. Roberts, G.D. Foster, Dept. of Chem., George Mason Univ., Fairfax, Va. 22030-4444. Nutrient enrichment is a known explanation for various algal and bacterial overgrowth in numerous waterways. However, the source of this enrichment is difficult to determine. For this study 11 steroid to cholesterol ratios were evaluated as potential biomarkers for chicken waste contamination. Coprostanone and coprostanol ratios are currently used to determine human waste pollution. Ratios were compared from two sediment samples, the Pocomoke River and Baltimore Harbor, and chicken waste. A ratio in the sediment similar to the chicken manure would indicate a possible biomarker. The results did not find a similar ratio in either the sediment samples, but evidence of human waste contamination was found. Further study needs to be done to determine if a biomarker can be located.

REPRODUCTIVE CHARACTERISTICS OF MALE MULE DEER (*Odocoileus hemionus*) FROM COLORADO. Minh Quoc Lu and Patrick F. Scanlon, Dept. of Fisheries and Wildlife Sciences, V.P.I.&S.U., Blacksburg, VA 24061-0321. Reproductive organs were recovered from male mule deer during hunts at the US Air Force Academy grounds in Colorado Springs CO. Data were obtained for deer in November and December, 1993 and 1994. Masses of testes and epididymides were taken and spermatozoan counts were made on epididymides. Ages of deer were noted. Data were compared by month and by age of deer. Testes mass increased significantly with age as did epididymal mass. Spermatozoan numbers per gram of epididymal tissue did not differ among adult males and significantly decreased from November to December. This decrease in December probably reflects spermatozoan use without replenishment during the late November breeding season.

HYDROGEOLOGY AND TRANSPORT OF PCB'S IN AN URBAN WATERSHED OF THE CHESAPEAKE BAY. Eldon C. Roberts Jr. and Gregory D. Foster, Dept. of Chemistry, George Mason University, Fairfax, VA 22030. Dissolved and particulate phase fluxes of polychlorinated biphenyls (PCBs) were determined during baseflow and stormflow at the fall lines of the Northeast and Northwest Branches of the Anacostia River near Washington, DC. PCB fluxes from this small urban watershed were primarily in the particulate phase during storm flow. This phase distribution means that high levels of PCBs will be deposited in the tidal river's benthic community. PCB fluxes in this small urban watershed indicated higher fluxes per square kilometer of basin area than other less urbanized watersheds.

ACID INSOLUBLE RESIDUES IN FECES OF DIVERSE HERBIVORES AS ESTIMATORS OF SOIL INGESTION. A. J. M. Russell, J. A. Crawford, and P.F. Scanlon, Dept. Fisheries and Wildlife Sciences, V.P.I.&S.U., Blacksburg, VA 24061-0321. Most herbivorous wildlife species ingest considerable amounts of soil while grazing/browsing (geophagia), either voluntarily or involuntarily by ingesting substrate that is adherent to their food source (in the form of dust and mud). Assessment of soil ingestion in wild species is frequently dependant on measurements from feces. Concentrations of Acid Insoluble Residue (%AIR) in feces provide a reasonable estimate of soil ingestion. Several species of herbivores from Australia, Ireland, Germany, and Virginia, U.S.A. had feces analyzed for %AIR. Marsupials from desert regions in Australia had %AIR as high as 17%: donkeys (*Equus asinus*) from the same regions had 14%. Agile Wallabies (*Macropus agilis*) from tropical regions had lower %AIR than the desert dwelling species. European Rabbit s(*Oryctolagus cuniculus*) and Fallow Deer (*Dama dama*), and White-tailed Deer (*Odocoileus virginianus*) had low %AIR values (1.54, 0.81, and 1.13, respectively). Capercaillie (*Tetrao urogallus*) feces from Germany had high amounts of AIR (mean=10.48), reflective of their habit of ingesting grit.

MICROBIAL SUCCESSION IN AEROBIC COMPOSTING SYSTEMS. Melanie Seifert and June Middleton, Dept. of Biol., James Madison Univ., Harrisonburg, Va. 22801. A lab-scale passive aerobic composting system was used to evaluate the ability of pine shavings, kenaf, white paper, saw dust, and switchgrass to immobilize soluble nitrogen and phosphorus in poultry litter. Triplicate samples of poultry litter and each carbon source were mixed at a C:N of 25:1. Triplicate compost samples were incubated for 14 days each at 58C, 37C, and 24C. Moisture content was maintained at 60%. The measured composting parameters included gravimetric moisture, pH, soluble nitrate and phosphorus, microbial respiration, and differential microbial community counts. When composting reaches completion there is an observable decrease in microbial respiration; no decrease was observed in any compost indicating continuing microbial activity. Spot plates in triplicate on TSA, cellulose, starch, minimal, Sabouraud, and MacConkey media were incubated at the composting temperature. Since poultry litter introduced the same microbes into each compost, differences in populations were due to the C sources. The heterotroph:autotroph remained constant throughout composting in all samples. White paper:PL compost contained the highest numbers of cellulose degraders. The smallest total populations were found in kenaf:PL compost, Fungal populations increased during mesophilic incubation in all composts. Casein hydrolysis indicated defined shifts in population at 37C.

SONICATION VS. SOXHLET: EXTRACTION OF PAHS AND PCBS FROM AQUATIC SEDIMENTS. Megan E. Thurmond, G.D. Foster, K. Lauer, R. Ghei, T. Huff*, & B. Roberts, Dept. of Chem., George Mason Univ., Fairfax, Va. 22030-4444. Both PAHs and PCBs are of importance because of their status as environmental pollutants. They are routinely extracted and examined in the environmental lab for their quantities in water and sediment. Finding the most efficient extraction method is crucial for environmental control issues as well as health issues. Extraction efficiencies are compared between two standard sediment extraction methods that are routinely used in the environmental chemistry laboratory, ultrasonic and Soxhlet. Results suggest that neither method is preferable in terms of extraction amounts of polycyclic aromatic hydrocarbons (PAH) or polychlorinated biphenyls (PCB) contained in a NIST SRM catalogue number 1941a.

IRON-OXIDIZING BACTERIA IN THE RHIZOSPHERE (ROOT ZONE) OF WETLAND PLANTS: A SURVEY OF A NOVEL MICROBIAL NICHE. Johanna V. Weiss^{1,2}, J. Patrick Megonigal¹, and David Emerson^{2,3}. ¹Department of Biology, George Mason University, Fairfax, VA 22030, ²Institute for Bioscience, Bioinformatics, and Biotechnology, Manassas, VA 20110, ³American Type Culture Collection, Manassas, VA 20110. The presence of iron-oxidizing bacteria in iron coatings on wetland plant roots is unknown. We surveyed a large range of wetland environments for the presence of rhizosphere iron-oxidizing bacteria in order to determine the relationship between bacterial cell densities, root plaque iron concentrations, pH, and soil characteristics. Iron-oxidizing bacteria were found in 90% of the sites and in the rhizosphere of 80% of the plant specimens, representing a total of 18 different species. While unable to establish significant relationships between soil characteristics and iron plaque concentrations, we found a significant correlation ($r^2 = 0.60$; $p < .01$) between the bacterial numbers and iron present on roots of *Sagittaria australis*. Our results show that iron-oxidizing bacteria are common in the rhizosphere of wetland plant species growing in a wide range of environments. We suspect that these bacteria may affect iron oxidation kinetics on root surfaces.

THE EFFECTS OF ENVIRONMENTAL LEAD EXPOSURE ON THE SURVIVAL OF AMERICAN BULLFROG TADPOLES AT DIFFERENT STAGES OF METAMORPHOSIS. Vonita L. Willis and James A. Wise, Dept. of Biol. Sci., Hampton Univ., Hampton, Va 23668. Lead toxicity is still a major health problem in the U.S., especially in children. Children exposed to low lead levels show a variety of developmental defects. In spite of these data, the lowest level of lead exposure that a child can safely be exposed to has not yet been established. Our laboratory is in the process of developing an American Bullfrog (*Rana catesbeiana*) larval model to investigate the effects of chronic, low level lead on their immune and central nervous systems. These data from this developmental amphibian model will be used to develop a risk assessment model for low level lead exposure in developing human beings. Initial studies were done to establish the effects of high dose lead exposure in this model. *Rana* larvae were exposed to high concentrations of lead nitrate solutions for 24 and 48 hr in an acute toxicity test. We found that the test organisms were differentially sensitive to lead at different developmental stages, as seen by statistically significant differences in the concentration of lead that killed 50% of the organisms (LC50). We also found that significant amounts of lead were absorbed into the bodies of the larvae. These data will be used to establish conditions for chronic toxicity testing using lower, non-lethal lead concentrations for longer periods of time.

Geography

TEMPORAL AND SPATIAL ANALYSIS OF PRECIPITATION PATTERNS: 1931-1996. Susan Vidal and Richard Diecchio, Dept. of Geography and Earth Science, George Mason Univ., Fairfax, VA. Precipitation data from 77 sites in the continental U.S. over a 66-year period were analyzed using a variety of exploratory techniques. An index of precipitation variability was developed that incorporated all observations at all sites into a standardized measure of deviation from the mean at each site. Variability was analyzed seasonally as well as regionally. Negative phases of SOI (Southern Oscillation Index) were found to correspond to increased precipitation variability when analyzed by season and by year. SOI was found to correlate with increased fall, winter and spring precipitation variability in the western half of the country. A weak correlation between increased summer precipitation variability in the Midwest and SOI was also found. NAO correlated strongly with increased spring precipitation variability along the Pacific coast and in the northern Rocky Mountains region. A weak correlation was also found between NAO and increased winter precipitation variability in the Midwest. Precipitation variability has increased during this 66-year period for all seasons except winter, with the greatest increase in spring and summer. These increases in precipitation variability have intensified since the 1960s.

BIODIVERSITY CONSERVATION AND BIOPROSPECTING: AN ANALYSIS OF BENEFITS SHARING PROPOSALS. Chikako Takeshita, Science and Technology Studies Prog., Va Tech, Blacksburg, Va. 24061, William E. O'Brien, Dept. of Geog., Radford Univ., Radford, Va. 24142, & Wairimū N. Njambi*, Science and Technology Studies Prog., Va. Tech, Blacksburg, Va. 24061. Bioprospecting agreements have been proposed as a potentially important means of conserving rapidly diminishing biodiversity, especially in areas of the Third World. Referring to the screening of plants materials for possible commercial uses, bioprospecting is promoted as a way to both generate economic growth and conserve resources. While past bioprospecting often resulted in "biopiracy," the Convention on Biological Diversity mandates that commercial and scientific bioprospectors share benefits with source countries and communities. Though the rhetoric of bioprospecting agreements emphasizes equitable outcomes thereby providing benefits to all stakeholders, proposals fail to adequately challenge prevailing unequal power relations, thus rendering equitable outcomes questionable.

A GEOGRAPHICAL ANALYSIS OF SOIL DISTRIBUTION IN THE SOUTH GOOSE CREEK WATERSHED, LOUDOUN COUNTY, VA. Mollie Fletcher-Klocek, Dept. of Geography and Earth System Sciences, George Mason Univ., Fairfax, Va. 22030. In this project several soil types in the South Goose Creek watershed of Loudoun County Virginia were investigated and possible reasons for the differences in the soil types were hypothesized. A geographic information system database was obtained from Loudoun County and the information concerning the soil types, the underlying geology, and the topography was selected for analysis. ArcView was used to analyze the different soil types and the possible contributing factors in the formation of those soils. It was concluded that the parent material on which the soil was formed, and the topography of the area are the two major factors in the determining soil type. The parent material determines weathering rates and the basic elements that are available for soil formation. The topography reflects the slope, the amount of relief of the land, and the influences of microclimates on different areas.

EVALUATION OF COASTAL APPLICATIONS OF GPS REFLECTANCE. Thomas R. Allen, Department of Political Science and Geography, Oertel, G. F., Department of Ocean, Earth and Atmospheric Sciences, Old Dominion Univ., Norfolk, Va. 23529. Recent investigations by NASA have illustrated a qualitative relationship between multipath GPS signals and surface roughness characteristics between the land and the sea. We have initiated studies to correlate reflected energy from the GPS signals to differences in coastal features ranging from wetlands, coastal lagoons, breaker zones and ocean swell. Using dual-difference GPS-delay mapping from overflights of Fishermans Island, Virginia, we integrate geometric locations of GPS specular points with spatial data on wetlands and surface water conditions. If the character of reflected GPS energy can be related to surf characteristics, there is also potential to use the character of multipath data to map longitudinal gradients in wave-energy density in the surf zone. Consequently, morphodynamic changes to Fisherman Island may be predicted from remotely sensed wave-energy density. GPS is also being used in Hog Island Bay, a barrier lagoon behind Hog and Cobb Islands on the Eastern Shore of Virginia. Some of the complex topography has been observed in TM images of the area and spectral classification of features have been correlated with depth data.

ASSESSMENT OF WETLAND INTRUSION INTO FARMLAND ON THE EASTERN SHORE OF VIRGINIA. Anne D. Watson, Dept. of Political Science and Geography, Old Dominion University, Norfolk, Va. 23529. The purpose of this paper was to determine the feasibility of using remotely sensed data, specifically, satellite images, and Geographic Information Systems to assess cropland invasion of wetlands in Northampton County on the Eastern Shore of Virginia. To do this, I used Landsat MSS images from three different dates, as well as a 1:24000 DEM of the Townsend quadrangle, a portion of Northampton County. Post-classification change detection and image differencing were used to determine areas of change, and the image differencing output and the DEM were used to create a spatial model to determine future areas where wetland inundation might occur. I concluded that a longer time span of images and greater spatial resolution was needed to see small-scale changes; aerial photography is a possible alternative. GIS proved to be an ideal tool for predicting areas most likely to be affected in the future by invading wetlands, as DEMs can be displayed and manipulated to allow for easy identification of low-lying areas and depressions.

Geology

CREATING A BIOGEOCHEMICAL MODEL FOR DEPOSITION OF THE LATE PENNSYLVANIAN, ORGANIC-CARBON-RICH, EUDORA CORE BLACK SHALE FROM NEAR EDGERTON, KANSAS, U.S.A. Jessica Debusk and Parvinder S. Sethi Dept. of Geol., Radford Univ., Radford, VA 24142. The Endora Core Black Shale is a typical cyclothemic shale representative of sediment accumulation at a time of sea-level highstand. It outcrops widely in the midcontinental U.S. and is known to have accumulated in deep, oxygen-depleted, benthic paleoenvironment. A millimeterscale investigation of the mineralogy, sedimentology and organic and inorganic geochemistry of this unit, however, reveals that it accumulated under a rather dynamic, variable paleoenvironment – one that was subject to strong fluctuations of both surface-water primary productivity and level of dissolved oxygen. Results show a high degree of variability in content of fecal pellets and phosphate nodules that are interpreted as indicators of enhanced primary productivity events that were most likely coupled with diminished to no oxygen in the benthic environment during such times. Concentrations of Pb over 27,000 ppm in conjunction with above-average levels of other heavy metals are a cause for concern regarding the behavior of such anoxic shale intervals as source materials for leaching of metals to the groundwater and therefore warrant further study.

CONCENTRATION OF HEAVY METALS IN STREAM SEDIMENTS IN THE VICINITY OF THE BOWERS-CAMPBELL ZINC MINE, TIMBERVILLE, VA. Diantha B. Garms, Dept. of Geol. and Env. Studies, James Madison Univ., Harrisonburg, Va. 22807. The Timberville area has various zinc belts associated with the Beekmantown formation. The Bowers-Campbell zinc mine commercially exploited these deposits from 1956 to 1963. The objective of research was to determine if the heavy metals associated with the mine are being released into streams. Interestingly, the crushed stone from the mine has been applied to agricultural fields as lime in the past; the impact of the mine may be more widespread than once thought. A total of thirty-one, fine-grained stream sediment samples were collected along the western stream. Analyses for Zn, Pb, and Cu were conducted using standard flame atomic absorption methods after separate hot and cold extractions. Whether the streams were dry or wet did not significantly affect the mean data. A positive correlation was found between the extractions for Zn, Pb, and Cu: 0.58, 0.35, and 0.80, respectively. Hot extraction ranges were 47–420 ppm, 29–69 ppm, and 11–49 ppm, respectively. All three concentrations were significantly above natural ranges for average streams. Cold extraction ranges were: 1–22 ppm, 6–16 ppm, and 1–7 ppm, respectively, indicating mechanical movement of the elements. Zn had the lowest hydromorphic ratio, and Pb had the highest. Downstream dispersion analysis suggests that hot extractable Zn and cold extractable Zn and Cu best indicated the location of the mine. Standard deviation was used to determine background, anomalous, and highly anomalous samples for combined data from the western and eastern streams. Six out of the nine western samples taken downstream from the mine were moderately anomalous for Zn. Results indicate that the eastern stream had a lower concentration of heavy metals than the western stream, possibly because it was farther away from the mine. Highly anomalous values of the metals were found in an area to the southwest of the mine, suggesting the presence of a previously undiscovered area of Zn mineralization.

ANALYSIS OF MARE BASALT STRATIGRAPHY USING CLEMENTINE DATA. Noel W. Jackson*, Dept. of Ocean, Earth and Atmospheric Sciences, Old Dominion Univ., Norfolk, VA 23529, Paul D. Spudis*, NASA-Houston, and G. Richard Whittecar, Ocean, Earth and Atmospheric Sciences, Old Dominion Univ., Norfolk, VA 23529. Remote sensing analyses of data set taken by Clementine in 1994 permit new observations about mineral distribution on the lunar surface, basalt flow stratigraphy, and the geologic evolution of the Moon. The northern section of Oceanus Procellarum contains numerous impact craters, which penetrated the basalt and thus can be used as natural probes to estimate the number and thickness of flows. Mosaics of images taken in three frequencies (415 nm, 750 nm, 950nm), and Ratio Images (750/415 = red, 750/950 = green, 415/750 = blue) formed the basis for analyses. On the Ratio Images, red indicates iron-poor mature highland regolith and titanium-poor basalts; green, freshly exposed mafic surfaces; blue, titanium-rich basalts and immature (freshly exposed) highland regolith. Use of an algorithm developed by Lucey et al. (1996) produced and Iron Image needed to identify flows exposed on crater walls. These images show that basalt flows in Oceanus Procellarum change in composition over time and that different basalt layers can be correlated over large areas based on their composition. The northern portion of the mare contains widespread titanium-rich mare basalt and is bounded on the West by highland that is covered by anorthositic regolith. In eastern Oceanus Procellarum, the large craters expose at least two basalt flows greater than 1 kilometre thick; a titanium-rich surface unit is underlain by a titanium-poor unit that itself is underlain by anorthosite basement. The western portion of the study area is covered by the titanium-poor basalt except where anorthosite crust protrudes or where craters punctured through to anorthosite basement. The titanium-rich basalts are estimated to be approximately 1 billion years old and the titanium-poor basalts, 3.3 billion years old. In northern Oceanus Procellarum (area of 525,000 square kilometres), the volume of basalt exceeds 240,000 cubic kilometres.

DISSOLUTION OF CARBONATE ROCKS IN THE UPPER JAMES RIVER BASIN: HOW MUCH SEDIMENT IS DELIVERED TO THE COASTAL PLAIN? Christine Metzger* and David Harbor, Washington and Lee University, Lexington, Virginia;

We studied the insoluble residue of carbonate rocks in the upper James River basin to investigate sediment yield as opposed to denudation in the area. The carbonate rocks were dissolved with hydrochloric acid, and the insoluble residue was determined by filtering. The amount and type of residue varies from rock to rock, and specifically from formation to formation. Samples were taken from both residue-rich and pure formations. For example, the percent insoluble residue varied from 9.06% (Lincolnshire) to 35.98% (Martinsburg). The Elbrook varied most widely, from 6.7% to 39.6%, while the Beekmantown remained the most constant. After performing extensive field observation of and sample collection from most of the formations in the Valley, cross sections of the county were constructed and the appearance of the valley pre-erosion was approximated and reconstructed. The relative amount of sediment (in the form of its insoluble residue) each formation possibly contributed to the sediment load was then calculated from the reconstructed cross sections

VEGETATION CLASSIFICATION AND SOIL MOISTURE ANALYSIS VIA REMOTE SENSING TECHNIQUES, FISHERMAN ISLAND, VA. *Kathleen Overman, *Jonathan Navarro, and Dr. Thomas Allen, Department of Ocean, Earth, and Atmospheric Sciences; Department of Political Science and Geography, Old Dominion University, Norfolk, VA, 23529. The purpose of this study is to determine whether a correlation exists between soil moisture and plant distribution on Fisherman Island, VA. Digital Landsat TM imagery and aerial photography were analyzed to determine if soil moisture distinctions could be derived via this imagery based on vegetation type and distribution. An analysis of an unsupervised vegetation classification with a 91.6% overall accuracy was compiled and used as a device to delineate the soil moisture zones on the island that were ground checked by a soil moisture meter. Based on this study it is concluded that soil moisture estimates can be obtained by studying the vegetation patterns of a relatively undisturbed area, such as Fisherman Island.

PEAKS, PLAINS AND POTHoles: ANALYSIS OF WATER LEVEL FLUCTUATIONS IN DEPRESSIONAL WETLANDS. G. Richard Whittecar, Dept. of Ocean, Earth and Atmospheric Sci., Old Dominion Univ., Norfolk, VA 23529, Jennifer Wolny* and Michele Kokolis*, Dept. of Biological Sciences, Old Dominion Univ., Norfolk VA 23529. Use of equations for Effective Monthly Recharge (WEM) provides a time-weighted estimate of ground water recharge based upon many months of antecedent precipitation and temperature. Selection of two variables (n: D) in this model rely upon comparisons of fluctuations in this WEM time series with measurements of water levels in ponds or wetlands. Once calibrated, these equations allow reconstruction of water levels for any period of time with weather records. This model has proven effective in depressional wetlands with simple hydrologic and geomorphic controls in many geologic settings. Green Pond and its wetlands lie in a shadow depression on a broad quartzite summit along the Blue Ridge in Augusta County, Virginia. Ground water feeding the pond passes through a thin regolith made of sandy residuum. Calibration, based upon 18 months of field data from monitoring wells, required use of 12 months of antecedent weather data (n) for each WEM estimate. The analysis suggests that Green Pond went dry for periods of 1 to 6 months approximately 6 times from 1977 to 1991. Ponds at maple Flats appear to be sinkholes in thick quartzite cobble gravels, formed where Pleistocene alluvial fans overlie carbonates in Augusta County, Virginia. Water level fluctuations at Kennedy Mountain Meadow from 1986 to 1998 (J. Knox, personal communication) indicate that the wetland goes dry during many years. Calibration of WEM values required an n of 6 months, suggesting that the catchment basin for this site is relatively small. Grafton Ponds are also sinkholes, formed in Coastal Plain sediments overlying shelly portions of the Yorktown Formation in York County, Virginia. Initial calculations of WEM (n=3) suggest fluctuations in these ponds also respond to precipitation and evapotranspiration in small catchment areas.

WATER QUALITY OF WOODS CREEK, VIRGINIA: IMPLICATIONS FOR LAND USE MANAGEMENT, John Wilbers* and Elizabeth Knapp, Washington and Lee University, Lexington, Virginia. Water Quality is an important issue because of our dependence on water for irrigation, drinking, and recreation. Therefore it is necessary to study the condition of our water sources. Woods Creek is one such waterway under scrutiny in Lexington, Virginia. The purpose of this study was to investigate the relationships between water quality and land use. GIS was used to establish land use zones within the watershed. Monthly sampling within each zone of factors such as temperature, pH, nutrients, and bacteria over a six month time period identified base conditions of the stream. Overall, according to the parameters studied, the stream was found to be healthy. However, in some instances the nitrate and coliform levels were found to be elevated. High nitrate levels (above 10ppm) were associated with rural land use. High coliform levels (above 200 colonies / 100ml) were associated with rainfall events. Although some important relationships were found, further study would be beneficial for greater modeling and broader trend analysis

EARTHSHOW: AN INTERACTIVE, MULTIMEDIA CD-ROM CREATED FOR TEACHING COLLEGE-LEVEL INTRODUCTORY GEOLOGY COURSES. Parvinder S. Sethi, Dept. of Geol., Radford Univ., Radford, VA 24142. The "EarthShow" interactive, multimedia CD-ROM was created for use with the "Foundations of Earth Science" (1999 edition) introductory-level, college text authored by Lutgens and Tarbuck. The CD-ROM was developed to help enhance comprehension of geological topics by students via a utilization of all seven of Gardner's "Multiple Intelligence" types (Gardner, 1986; 1993). The CD-ROM employs vast amounts of multimedia footage including slideshows, still images and audio - all of which are closely linked to the textbook chapters. Also included on the CD-ROM are "Self Assessment" exercises that utilize interactive, electronic technology for helping students master key diagrams/photographs/tables from the individual textbook chapters. Navigation through the CD-ROM is strongly non-linear and prompts a student to spend more "time on task" in a self-paced and self-guided environment.

A SEDIMENTARY AND GEOCHEMICAL INVESTIGATION OF FACTORS CAUSING COLOR IN A VARIETY OF GEORGIA SOILS AND SOIL-PAINTINGS: A MODEL FOR TEACHING MINERALOGY THAT BRIDGES SCIENCE AND ART IN A TRULY LIBERAL ARTS PERSPECTIVE. Parvinder S. Sethi, K.C. St. Clair, Abigail Quillen, Kelly Burton and John Boettcher, Dept. of Geol., Radford Univ., Radford, VA 24142. Mineralogy, as a subject, tends to be highly technical, deeply steeped in rigorous physical and chemical principles, demanding of 3-D spatial visualization skills and is often a challenge to teach in a "core" course environment. This project was undertaken by a team of students to investigate: a) the variety of colors that can be found in Georgia clays and soils, b) the geological and mineralogical basis for the generation of such naturally-occurring colors, and last but not least - c) "soil-scapes" - paintings created by Ms. Ola Payne, of Milledgeville, Central Georgia via use of exclusively clays and soils of different colors. Results of Neutron Activation Analysis (NAA) and of Inductively Coupled Plasma Mass Spectrophotometry (ICP-MS) reveal the dominant control of weight % Al, Cu, Cr and Ni on the colors observed in clays and soils. A set of "before" and "after" comments by the students involved in this project reveals that tying of mineralogy with art/aesthetics within an actual field setting can be a very powerful tool for not only bridging science and art but also for engaging the students' interest in the other, more abstract concepts of mineralogy at the college level.

POLLUTION-POTENTIAL OF ORGANIC-CARBON-RICH, HEAVILY PYRITIZED BLACK SHALES: CASE STUDY OF THE MIDDLE DEVONIAN, MILLBORO SHALE FROM SOUTHWESTERN VIRGINIA. Parvinder S. Sethi and Joseph Miller, Dept. of Geol., Radford Univ., Radford, VA 24142. The Middle Devonian, Millboro Shale is a commonly exposed unit in southwestern Virginia and accumulated in the paralic facies setting of a foreland basin. A pilot study of the mineralogy, sedimentology and geochemistry revealed high-resolution (centimeter- to millimeterscale) variations in organic carbon content, pyritization and concentration of barite. Reports of smelly well water and acidic discharge from the region prompted this investigation of the pollution-potential of these shales via weathering and runoff. The primary hypothesis was that polymetallic sulfide complexes exerted a dominant control on concentrations of potentially toxic, heavy-metal concentrations in such shales. Sampling was conducted on a centimeter scale and results strongly support the aforementioned hypothesis. The study interval is characterized by total organic carbon (TOC) contents of up to 7 weight %, a large range of pyrite sulfur (0.3 to over 25 weight %), systematic variation in weight % calcium carbonate and a strong positive relationship between Ni, Pb and Cu metals with weight % pyrite sulfur. We conclude that this interval of the Millboro Shale accumulated in a intensely anoxic, benthic environment – one that helped preserve high amounts of marine organic carbon and promoted formation and burial of pyrite along with trapped metals including Cu, Ni and Pb. Further research is needed to quantify the amount of pyrite in such shales of acidic discharge thus produced.

SEDIMENTOLOGY, MINERALOGY, ORGANIC AND INORGANIC GEOCHEMICAL INVESTIGATION OF THE MIDDLE DEVONIAN NEEDMORE SHALE FROM SOUTHWESTERN VIRGINIA: IMPLICATION FOR GROUNDWATER POLLUTION AND USE OF SUCH SHALES. Parvinder S. Sethi and Ryan Murley, Dept. of Geol., Radford Univ., Radford, VA 24142. The Needmore Shale is an important Middle Devonian unit that is widely exposed in the southwestern Virginia region. It underlies the older Millboro Shale and is stratigraphically separated from it by the Tioga bentonite. It accumulated as part of the detrital "Catskill Delta" lithofacies complex that accumulated from upstate New York south to Tennessee. The primary hypothesis of this study was that a high-resolution (centimeter-scale) investigation of this unit will reveal signatures of climatically-controlled fluctuations in paleoceanographic processes via variations in weight % calcium carbonate, total organic carbon and Al. Results show an inverse relationship between weight % Al and calcium carbonate indicative of sediment accumulation under varying conditions of high- and low sediment input to this benthic paleoenvironment. The level of oxygenation in this setting also varied from oxic to anoxic, with most metals being preserved during anoxic events. Lithologically, the Needmore Shale represents a massive, predominantly non-laminated, cohesive material that should be suitable for use as aggregate and for other similar engineering applications.

HISTORICAL SHORELINE CHANGES OF PARRAMORE ISLAND, VIRGINIA: 1871-1998. Susan Vidal and Randolph A. McBride, Dept. of Geography and Earth Science, George Mason Univ., Fairfax, VA. High water line positions derived from historical maps, aerial photographs and a GPS survey were superimposed in a GIS and used to quantify shoreline change on a tide-dominated barrier island on Virginia's Eastern Shore. Shorelines were compiled for the years 1871, 1959, 1980, and 1998. The Atlantic Ocean shoreline of Parramore Island can be divided into three zones based on rates of shoreline change. Zone 1, the high profile northern end of the island, although advancing between 1871 and 1959, has retreated at a rate of 2.2m/yr between 1980 and 1998. Zone 2 is the central part of the Atlantic shoreline. Characterized by high-profile, truncated beach ridges, it has been fairly stable historically, but is now retreating at a rate of 7.3 m/yr. Zone 3, the low profile southern end of the island, is washover dominated and has been retreating at a high rate for the entire study period (8.3 m/yr from 1871-1959, 5.5 m/yr from 1959-1980 and 13.0 m/yr from 1980-1998). The island has historically experienced clockwise rotational instability, with accretion in Zone 1, stability in Zone 2 and retreat and washover in Zone 3. Recent evidence suggests that geomorphic response for the entire island has changed from clockwise rotational instability to retreat in the north and landward rollover in the south.

Materials Science

CHARACTERIZATION AND MODELING OF A MICROWAVE DRIVEN EXCIMER LAMP.

*Joseph D. Ametepe, Jessie Diggs, Dennis M. Manos, and Michael J. Kelley, Department of Applied Science, College of William and Mary, Williamsburg, VA 23187. We designed, constructed, and studied a novel probe-coupled 2.45 GHz microwave arrangement to drive a Xe excimer lamp. The maximum in-range optical power was 60 W, more than 80% of the total. Cooling with liquid nitrogen boil-off rather than room air more than doubled output power. Model calculation and experimental measurement of the angular distribution of emission find considerable intensity well away from the surface normal. Correcting experimental measurements of excimer lamp output power accordingly brings good agreement with the 20%-40% electrical efficiency predicted by theory.

STUDY OF SHORT-TERM ATMOSPHERIC CORROSION OF CARBON STEEL Rama

Balasubramanian¹, Desmond C. Cook¹, T. Perez², and J. Reyes². ¹Department of Physics, Old Dominion University, Norfolk, VA 23529, U. S. A. ² Programa de Corrosión del Golfo de México, Universidad Autonoma de Campeche, C. P. 24030, Campeche, México. A systematic study has been made of the development of corrosion products formed on carbon steel atmospherically exposed for short times along the Gulf of México. Two sets of carbon steel coupons were exposed between 1 and 12 months at marine and near marine locations in Campeche, México, to study the corrosion as a function of time. The resulting corrosion products were analyzed by Mössbauer Spectroscopy, and x-ray diffraction in order to completely identify the oxides in the corrosion coating. The most abundant oxides present in the corrosion products were lepidocrocite and goethite. Transmission Mössbauer analysis of the spectra recorded at 77 K indicated that as a function of exposure time the amount of magnetic goethite decreased from 78 % to 62%. Mössbauer spectra of the corrosion products recorded at 4 K showed the presence of an x-ray amorphous phase whose hyperfine parameters corresponded to ferrihydrite with particle size < 8 nm. The ratio of α -FeOOH/ γ -FeOOH, measured by Mössbauer spectroscopy was found to be nearly 3.5 in carbon steel for short-term exposures. The layering of oxides in the coating was very similar to those observed in weathering steel.

THE APPLICATION OF ATOMIC FORCE MICROSCOPY (AFM) TO THE STUDY OF

SOL-GEL DERIVED PZT. Adora Christenson, Brian H. Augustine, Dept. of Chemistry, James Madison University, Harrisonburg, Va. 22807. Sol-gel prepared PZT (lead zirconate titanate) was synthesized using two different techniques, one involving a chelating agent and the other involving 2-methoxyethanol as a solvent. The molar ratios of Zr:Ti were varied in different solutions and thin films were deposited on silicon wafers. The resulting films were observed and compared with atomic force microscopy (AFM). A technique has been developed for depositing sol-gel onto ultra thin silicon wafers (9-10 μ m). This will be used in High Temperature AFM (HT-AFM) to observe real-time changes in the mechanical properties of sol-gel derived PZT thin films during the pyrolysis phase.

CONTRIBUTION OF CHROMIUM TO THE CORROSION PRODUCT FORMATION ON STEEL. Desmond C. Cook¹, Rama Balasubramanian¹, S. J. Oh² and M. Yamashita³, ¹Department of Physics, Old Dominion University, Norfolk, VA 23529, ²Pohang University, Korea and ³Himeji Institute of Technology, Japan. Corrosion products formed on Weathering and carbon steels exposed in the United States for 16 years have been analyzed. Mössbauer spectroscopy shows that about 80% of the corrosion coating is goethite for both steel types. However alloyed steel coatings contain about 60% nanophase goethite (<15 nm) compared to carbon steels which contain about 40%. Micro-Raman spectrometry shows that the corrosion coatings are layered with the inner layer comprised of goethite (95%) and magnetite and/or maghemite (5%). The outer layer consists of a mixture of lepidocrocite (80%) and goethite (20%). Electron Probe Micro-Analysis shows that for Weathering steels, about 5% chromium is incorporated in the inner layer whereas none is in the outer layer. Electron microscopy and Mössbauer analysis of synthetic goethite prepared with up to 10% chromium substituting the iron, shows that the goethite particle size reduces from 200 nm for pure goethite down to about 10 nm for chromium greater than about 4 wt.%. The Mössbauer and Raman data of the 5% chromium goethite is nearly identical to the nanophase goethite in the Weathering steel corrosion coatings. It is concluded that chromium in HSLA steels contributes to the formation and high fraction of nanophase goethite in the inner layer of the protective coatings.

AGGREGATION OF CALCIUM CARBONATE CRYSTALS AT THE AIR/ WATER INTERFACE. L. Gebremedhin, M. Lach-hab, H. Wickman, and E. Blaisten-Brojas, Institute for Computational Sciences and Informatics, George Mason University, MS 5C3, Fairfax, VA 22030. Precipitation in aqueous solution of calcium hydroxide $\text{Ca}(\text{OH})_2$ leads to calcium carbonate (CaCO_3) microcrystals which diffuse to the surface and undergo cluster-cluster aggregation to form fractal patterns. The fractal character of the aggregates was studied by optical microscopy and image analysis to derive their fractal dimension d_f . The fractal dimension depends slightly on the initial concentration of $\text{Ca}(\text{OH})_2$ and has a mean value of 1.74 for 0.15 g/L solutions. This is larger than the value of 1.48 derived by Nakayama, *et al.* J. Phys. Soc. Japan **64**, 1114 (1995) in similar experiments. An increase in the microcrystal size is observed with the age of the solution. Solutions aged 24 hours yield crystals of 25 μm on average. (Supported by the National Science Foundation, Grant CTS-9806321)

ACCELERATED AGING OF POLYIMIDE/TITANIUM ADHESIVE SYSTEMS. Rachel K. Giunta, Ronald G. Kander, Materials Science and Engineering Dept., Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. The effect of elevated temperature aging on the interphase of a polyimide adhesive and a titanium substrate has been investigated. An interfacially debonding adhesive test was applied, and the adhesive/substrate interphase was characterized through an analysis of the failure surfaces. To facilitate the aging study, an "open-faced" adhesive geometry was used. Use of this adhesive geometry allows an acceleration of diffusion-related aging phenomena by up to two orders of magnitude, as compared to a traditional "sandwiched" bond. The failure surfaces were characterized using x-ray photoelectron spectroscopy and optical microscopy. Bulk adhesive properties were investigated using differential scanning calorimetry, infrared spectroscopy, and solvent uptake. Although there was evidence of polyimide degradation within the interphase, only minor changes in the bulk polyimide properties were detected. This indicates that the adhesive may be degrading preferentially in the interphase region. (Supported by the Center for Adhesive and Sealant Science at Virginia Tech and the Adhesive and Sealant Council Education Foundation.)

VIBRATIONAL ANALYSIS OF CALCIUM CLUSTERS, J. Mirick and E. Blaisten-Barojas, Institute for Computational Sciences, George Mason Univ., MS 5C3, Fairfax, Va. 22030. The total energy and structure of small calcium clusters containing up to eight atoms was calculated by a density functional hybrid method in which the exchange is calculated by Hartree-Fock and the correlation by the generalized gradient approximation. A comparison is given to the energy and structure calculated from the Murrell-Mottram (MM) interaction potential (Mol. Phys., V69, pg. 571, 1990). It is demonstrated that the MM potential is not accurate to reproduce calcium clusters yielding energies that are too low and structures (N=6) that differ from the first principles calculations. A vibrational analysis based on the normal modes and thermodynamic properties will be presented.

FRactal PROPERTIES OF BINARY COLLOID MIXTURES. A. Sunaidi, M. Lach-hab, E. Blaisten-Brojas, Institute for Computational Sciences and Informatics, George Mason University, MS 5C3, Fairfax, VA 22030, & A. Gonzalez, Centro de Ciencias Fisicas, Universidad Nacional Autonoma de Mexico, Apartado Postal 48-3, Cuernavaca 62251, Morelos, Mexico. Three different models of aggregation process in binary colloidal mixtures are investigated via computer simulations. The models are characterized according to the bonding schemes between the different particles. Results show that the aggregates display self-similarity. The structural and the dynamical properties were found to depend on the concentration ϕ , and the composition X. Unlike the one-monomer system, critical values for ϕ and X were found, beyond which the sol-gel transition does not occur. (Supported by National Science Foundation, grant CTS-9806321)

OPTIMIZATION OF STRONTIUM CLUSTERS WITH GENETIC ALGORITHMS. G. Wang¹, E. Blaisten-Barojas¹, and A. Roitberg^{1,2}, ¹Inst. for Computational Sciences, George Mason Univ., MS 5C3, Fairfax, VA 22030. ²Nat. Inst. of Standards and Technology. The structure of strontium clusters of up to 60 atoms is optimized with genetic algorithms. The bonding scheme is modeled by a many-body potential based on the second moment approximation to the density of electronic states. The parameters for the potential are fitted on first principles calculations within the generalized gradient approximation of strontium clusters with up to N=19 atoms. Thermodynamic properties such as energy, free energy, specific heat and melting temperature are found to be size-dependent. Calculations on surface energy and surface relaxation of the FCC <111> surface were also performed. (supported by the Provost's office of George Mason University)

Medical Science

MITOCHONDRIAL FUNCTION IN INJURED ASTROCYTES AND NEURONS. S.M. Ahmed, B.A. Rzigalinski, K.A. Willoughby*, H.A. Sitterding* and E.F. Ellis, Dept. of Pharmacology and Toxicology, Medical College of Va., Va. Commonwealth Univ., Richmond, Va. 23298. The role of energy deficit in the pathology of traumatic brain injury (TBI) is unclear. Using an *in vitro* model of TBI, we tested the hypothesis that stretch injury leads to loss of mitochondrial membrane potential and subsequent energy deficit in astrocytes and neurons. Pure astrocytes, mixed neuronal/glial cultures and pure neuronal cultures were subjected to mild (5.7 mm), moderate (6.5 mm) or severe (7.5 mm) stretch injury. Mitochondrial membrane potential (MMP) was examined using the fluorescent dye rhodamine-1,2,3. Cellular ATP levels were measured using the luciferin-luciferase assay. MMP and ATP levels dropped significantly in pure astrocyte cultures 15 minutes after mild or moderate injury, but returned to normal levels by 24 hours. Neurons in pure embryonic cultures exhibited a decline in MMP only after severe (7.5 mm) stretch, which was sustained for 48 hours. However, neurons in neonatal mixed neuronal plus glial cultures displayed a drop in MMP 15 minutes after mild, moderate or severe injury that recovered within 24-48 hours. When embryonic neurons were cultured on astrocytes, they also became susceptible to loss of MMP after mild injury. Our findings indicate that injury leads to a reversible cellular energy deficit in astrocytes, and that the presence of astrocytes affects neuronal mitochondrial function after injury. We suggest that injury-induced deficits in astrocyte function may provoke mitochondrial deficits in neurons.

MOTHER KNOWS BEST: POTENTIAL ENHANCEMENT OF NEUROGENESIS IN THE RAT BRAIN DURING PREGNANCY AND LACTATION. Amor, E.A., Wartella, J.E., Plozsay, A.*, Williams, A.*, Dillon, A.*, Griffin, G.*, Beresik, M.*, Lambert, K.G.¹ & Kinsley, C.H. Department of Psychology, University of Richmond, Va 23173; and ¹Department of Psychology, Randolph-Macon College, Ashland, VA 23005. The brain is a much more plastic organ than previously thought – especially as a function of reproductive state. Steroid hormones such as estradiol (E₂) and progesterone (P), which modulate many behaviors in the female rat, can affect the morphology of neurons in adult females. Pregnancy, during which a female is exposed to a longer duration of elevated E₂ and P, may result in even greater changes in many systems than those reported during estrus. The current work examines the possibility that in addition to changes in existing neural structures, changes in reproductive capacity may influence the rate at which new neurons are born, so-called neurogenesis. Virgin, late-pregnant (day 21) or postpartum (day 1-2) females were generated and multiply injected with the dividing-DNA marker, bromodeoxyuridine (BrdU). The animals were anesthetized and then perfused with paraformaldehyde, and brains were processed with an antibody to BrdU. Every sixth 40- μ section (for 10 sections) through the dentate gyrus was assessed for total number of BrdU-immunoreactive (IR) neurons. Our preliminary data indicate that nulliparous females had the highest total of BrdU-IR neurons, compared to late-pregnant and early lactating. These data suggest that neurogenesis may be sensitive to reproductive condition and that pups may represent a kind of enriched environment, which has been shown by Gage and his colleagues to enhance neurogenesis. Females thus equipped may be better able to respond to the new challenges and learning demands characteristic of motherhood. Thereby, the young may enhance their own survival.

HUMAN LIVER MICROSOMAL UDP-GLUCURONOSYLTRANSFERASES AND THE N-GLUCURONIDATION OF 4-AMINOBIIPHENYL. Aucung, D.J., F.K. Kessler, and J.K. Ritter, Dept. of Pharmacology & Toxicology, VA Commonwealth Univ., Richmond, VA 23298. Arylamines found in cigarette smoke, e.g., 4-aminobiphenyl (4AB), are proven human bladder carcinogens. Variation among individuals in the rate of metabolism of arylamines may influence the individual risk of bladder cancer. N-Glucuronidation by the liver is a major pathway in the metabolism of arylamines. The specific UDP-glucuronosyltransferase (UGT) isoform(s) involved in arylamine N-glucuronidation are unknown, but UGT1A1, UGT1A6, UGT1A9, and especially UGT1A4 are implicated. To begin to address this, we analyzed liver microsomal samples from 16 human liver donors for variation in 4AB UGT activity and possible correlation with the levels of UGT1A1 and UGT1A4 as determined by immunoblot analysis. Antibodies directed against residues 29-159 and 30-160 of UGT1A1 and UGT1A4, respectively, were raised in mice. The specificities of the antibodies were demonstrated by immunoblot analysis of UGT1 fusion proteins and rat and human liver microsomes and hepatocytes. UGT1A1 levels in human liver microsomes (>50-fold variation) correlated poorly with either 4AB UGT levels (6.3-fold variation, r²=0.16) or UGT1A4 levels (6.7-fold variation, r²=0.09). In contrast, UGT1A4 levels (6-fold variation) showed stronger correlation with 4AB UGT levels (r²=0.68). These data suggest that UGT1A4 is one of the primary isoforms responsible for the total 4AB N-glucuronidation activity of microsomes. (Supported by NIEHS grant ES07762).

AMPHETAMINERGIC ACTIONS OF PHENYLPROPANOLAMINE ANALOGS. M. Bondarev, R. Young,* and R. A. Glennon. Department of Medicinal Chemistry, Virginia Commonwealth University, Richmond, VA 23298. Amphetamines are an important class of central stimulants and drugs of abuse. Although their structure-activity relationships have been well investigated, the role of oxygenated substituent at the β -position in agents such as norephedrine and ephedrine is not yet clear. Perhaps the presence of a β -hydroxyl group might reduce the ability of amphetamine (AMPH) analogs from penetrating the blood-brain barrier, making them appear less potent. With the aim of assessing the role that β -oxygen substituents might play in producing AMPH-like stimulus effects, we synthesized and evaluated a series of β -oxygenated amphetamine analogs, taking into account stereochemical features of these molecules. The AMPH stimulus generalized to only two phenylpropanolamines: (-)ephedrine ($ED_{50} = 4.52$ mg/kg) and (+)norpseudoephedrine ($ED_{50} = 7.99$ mg/kg). The β -oxygenated amphetamine analog 4-methylaminorex (4-MAX) appeared as a street drug several years ago; however its oxygen function is constrained in a cyclic system. Three of its four optical isomers have shown significant AMPH-like stimulus effect ($ED_{50} = 0.25$ - 1.22 mg/kg) in animals trained to discriminate (+)AMPH. We prepared other 4-MAX-like "hybrid" molecules. Some of these were found to be unstable. Other newer hybrids are more stable and are currently being evaluated in drug discrimination. Apparently, both the stereochemistry and the polar nature of the β -oxygen function contribute to potency. [Supported by DA-01642].

REDUCED CO BOOST PRODUCED IN HUMANS SMOKING A NOVEL SMOKING SYSTEM. August R. Buchhalter, & Thomas Eissenberg; Dept. of Psychology, Va. Commonwealth Univ., Richmond, VA 23298. A novel smoking system (Accord[®]), intended to reduce second-hand smoke, is being marketed to "light" and "ultra-light" cigarette smokers. The system consists of a hand-held chamber into which specially constructed cigarette-like tubes are inserted. Puffing on the tube, which protrudes from the chamber, results in electronic heating of pressed tobacco. When using this system, smokers do not experience many smoking-related cues (e.g., cigarette lighting, burning tip). The system limits smokers to 8 puffs. This study examined the possibility that smoking behavior may be altered when smoking the novel system, perhaps due to the reduction of smoking-related cues or limited puff availability. Ten smokers of "light" or "ultra-light" cigarettes smokers ($cpd > 10$) participated in this study and were required to abstain from smoking for at least 8 hours before each of two approximately 3-hour long sessions. Abstinence was verified by expired CO levels less than 10 ppm. Puff topography, expired CO, vital signs, and subject-rated measures were assessed periodically within each session as subjects smoked either their usual brand or the novel system at 30-minute intervals for two hours. Results show that smokers take smaller puffs when smoking their usual brand relative to when using the novel system. Skin temperature decreased in both conditions, consistent with nicotine delivery. The expired air CO boost observed after usual brand smoking was less after using the novel system. The novel system may lead to altered topography and appears to deliver nicotine with little increase in expired CO. (Supported by PHS grant DA 11082.

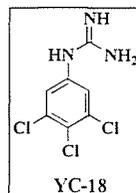
ROLE OF FAS LIGAND-BASED APOPTOSIS INDUCED BY TCDD AS A MECHANISM OF IMMUNOTOXICITY IN PERIPHERAL T CELLS ACTIVATED THROUGH THE T CELL RECEPTOR. L. Camacho¹, M. Nagarkatti¹, and P. S. Nagarkatti². ¹Dept. of Biomedical Sciences and Pathobiology, VA-MD Regional College of Veterinary Medicine, and ²Dept. of Biology, Virginia Tech. Previous studies from our laboratory have shown that treatment with TCDD inhibits the responsiveness of antigen-activated but not naive T cells from C57BL/6 +/- mice. In the current study, we investigated whether this decreased responsiveness of such T cells resulted from increased apoptosis following restimulation. To this end, C57BL/6 +/- mice or C57BL/6 *gld/gld* (Fas ligand defective) mice were injected with TCDD (50 μ g/kg body weight, i.p.) and with anti-CD3 mAbs into the footpads. Five days later, axillary lymph nodes cells (source of naive T cells) and popliteal lymph nodes cells (source of activated T cells) were cultured *in vitro* with anti-CD3 mAbs and cell proliferation was measured. Also, such cells were studied for their ability to undergo apoptosis upon *in vitro* culture. The data demonstrated that activated but not naive T cells from TCDD-treated wild-type (+/+) mice showed a significant decrease in their responsiveness to anti-CD3 mAbs. Also, such cells exhibited increased levels of apoptosis. In contrast, both naive and activated T cells from C57BL/6 *gld/gld* mice showed normal responsiveness to anti-CD3 stimulation. Also, the activated T cells from TCDD-treated *gld* mice failed to exhibit increased apoptosis. The current study demonstrates that the immunotoxic effects of TCDD on activated T cells may be mediated through Fas-ligand based apoptosis. (Supported in part by grants from NIH and EPA.)

ROLE OF ENDOGENOUS OPIOIDS IN MINOXIDIL-INDUCED ANTINOCICEPTION. Vera C. Campbell, William L. Dewey, and Sandra P. Welch. Dept. of Pharm. and Tox., Va. Commonwealth Univ., Richmond, Va. 23298. Morphine is an opioid that is the drug of choice in the treatment of severe, acute pain. However, long-term morphine use can produce undesirable effects such as tolerance and physical dependence. It has been shown that K-ATP channels are important during morphine tolerance. The K-ATP channel is the site of action for oral sulfonylureas like glyburide. Morphine is a K-ATP opener that hyperpolarizes the cell leading to a decrease in Ca^{2+} conductance, which decreases neurotransmitter release and thus contributes to morphine's antinociceptive effects. Upon repeated administration of morphine there is an increase in both the K_D (4-fold) and B_{max} (3-fold) at the sulfonylurea receptor. These cellular events may contribute to morphine tolerance. Drugs such as minoxidil share with morphine the ability to open potassium channels, moreover, minoxidil produces a profound antinociceptive effect when administered centrally which is blocked by opioid antagonists. Utilizing the spinal perfusion method, male Sprague Dawley rats were perfused with a 20 μ l bolus of minoxidil and antinociception was measured using the tail-flick latency test. The %NPE for minoxidil (100 μ g) was decreased from 94% to 1.5% MPE in the presence of naloxone. Minoxidil differentially releases leucine (minoxidil 19 ± 6 pg/ml vs. DMSO vehicle 3.1 ± 2 pg/ml) and not methionine enkephalin (minoxidil 16.4 ± 0.7 pg/ml vs. DMSO vehicle 14 ± 1.6 pg/ml) indicating the involvement of the delta opioid receptor in minoxidil-induced antinociception. Also, inactive doses of minoxidil (25 μ g) and morphine (0.025 μ g) combined, produces an effect (100% MPE) which is greater than that of either drug alone which may be due to mu/delta synergism. This data indicates that modulators of the K-ATP channel may be useful in combination with morphine to prevent morphine tolerance and physical dependence by decreasing the dose of morphine required to produce analgesia. We further hypothesize that the mechanism underlying the action of the K-ATP openers in enhancing morphine is via endogenous opioid release. (Supported by DA01647, KO2DA00186, and DA07027)

IMPURITIES IN ILLICIT METHAMPHETAMINE: STUDIES WITH CHLOROEPHEDRINE AND 1,2-DIMETHYL-3-PHENYLAZIRIDINE. Karen M. Carter*, W.H. Soine*, V. Leksukulchai*, A. Poklis*. *Dept. of Medicinal Chem., Sch. of Pharmacy and †Dept. of Path., Sch. of Med., Va. Commonwealth Univ., Richmond, Va. 23298-0540. 1,2-Dimethyl-3-phenylaziridine (AZR) and their chloroephedrine (CEP) precursors have been reported as impurities in illicit methamphetamine. This study describes the synthesis, stability, and analysis of these potentially reactive compounds. When the HCl salts of either (-)-ephedrine or (+)-pseudoephedrine is reacted with $SOCl_2$ using literature procedures, pure (+)-CEP can be isolated in a 45-70% yield. Pure (-)-CEP can be obtained from the reaction of (+)-pseudoephedrine with PCl_5 in a 20-30% yield. 1H NMR of the CEP salts was used to differentiate and quantitate diastereomer ratios by comparing the N-methyl peak heights. Additional 1H NMR data proved that the CEP's were stable at pH 5.5-6.0 for extended periods. At pH 7.4 these compounds rapidly underwent cyclization to form the aziridines. The aziridines exhibit limited stability. The *trans* isomer readily decomposes into a polymeric material. Further research will focus on the pharmacological activity of the CEP's.

IMPROVING STROKE THERAPY: REDUCTION IN INFARCT VOLUME AFTER REPERFUSION IN THE RAT USING TEMPOL, A STABLE NITROXIDE RADICAL. Dan Chao^{1,2}, Ramin Rak, M.D.^{1*}, Joe C. Watson, M.D.^{1*}, Edward H. Oldfield, M.D.¹, ¹Surgical Neurology Branch, NINDS, ²Virginia Commonwealth University. The modest effect of thrombolytic agents in treatment of stroke may be due to reperfusion injury, damaging biochemical processes initiated by reoxygenation of ischemic tissue. Reactive oxygen species (ROS), generated on reperfusion, have been implicated to play a role in this process. Scavenging these ROS may be of therapeutic value in increasing the effectiveness of current thrombolytic treatments. Nitroxides are low weight stable free radicals that mimic superoxide dismutase (SOD) the body's natural mechanism for scavenging ROS. One of these nitroxides, Tempol, is lipid soluble and freely crosses the blood brain barrier. This study investigates this molecule to determine its ability to reduce reperfusion injury and infarct volume in the rat. Sprague-Dawley rats (280-350g) underwent middle cerebral artery occlusion (MCAO, 60 min) using an intraluminal suture. Following reperfusion, the animals were randomized to blind IV administration of either Tempol (10 mg/kg)(n=8) or vehicle(n=8) over the first 20 minutes of reperfusion. 4 hours after reperfusion, the brains were removed and stained with rITC. Infarct volumes were measured by computerized imaging. Animals receiving IV Tempol had substantially smaller infarcts than controls (101.2 ± 65.5 mm³ vs. 194.3 ± 78.2 mm³, p=0.02). No significant differences in weight, blood pressure, cerebral temperature, or rectal temperature were observed between groups. With the emergence of thrombolytic agents, the treatment of reperfusion injury has become an important goal in this new age of stroke therapy. These results encourage further study of this molecule for use as a therapeutic agent in reducing damage after cerebral thrombolysis.

EXPLOITATION OF A NOVEL CLASS OF 5-HT₃ AGONISTS Y. Choi¹, M. Dukat,¹ M. Teitler,² R. A. Glennon¹. ¹Department of Medicinal Chemistry, Virginia Commonwealth University, Richmond, VA 23298 and ²Albany Medical College, Albany, NY 12208. 5-HT serotonin receptors are composed of 7 families and more than 15 sub-populations. 5-HT₃ receptors have attracted widespread attention because of their possible involvement in pain, anxiety, psychotic behavior, and memory disorders. Although many 5-HT₃ antagonists have been developed, there are very few agonists. Our long term research goal is the development of selective, high-affinity 5-HT₃ agonists. We and others have identified phenylbiguanides as 5-HT₃ agonists, but they either lack high affinity or have difficulty penetrating the blood brain barrier. Recently we have found that phenylguanidines possess agonist activity, and structure-activity studies have identified YC-18 (5-HT₃, K_i = 0.7 nM) as a very high-affinity ligand.



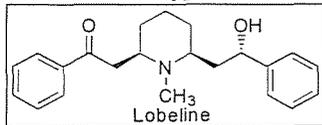
ENHANCEMENT OF OPIOIDS BY DELTA-9 THC SUGGESTS POTENTIAL FOR CHRONIC TREATMENT WITHOUT TOLERANCE. Diana L. Cichewicz and Sandra P. Welch. Dept. of Pharmacol., Va Commonwealth Univ., Richmond, Va. 23290. Long-term administration of opioids such as morphine can lead to development of tolerance to the drug's analgesic effects and is often accompanied by many adverse side effects due to high drug dosage requirements. Therefore, the prevention of tolerance is a very important issue in opioid drug studies. Recent evidence which shows that delta-9 tetrahydrocannabinol (THC) is useful in enhancing the analgesic properties of opioids suggests a promising use for THC as an adjunct to opioid therapy in order to reduce tolerance formation. We examined the efficacy of a combination of low oral doses of THC and morphine in tolerant mice. This combination was equally effective in vehicle-treated and morphine-tolerant mice, indicating that analgesia produced by the combination is not hampered by the presence of opioids already in the system. Animals tolerant to THC showed a decreased response to the combination, implying that the cannabinoid component of the combination is critical in the enhancement of opioids by THC. We also evaluated the combination of low oral doses of THC and morphine for potential tolerance formation in mice. Mice were treated twice daily for 6.5 days with a combination of 20 mg/kg THC p.o. and 20 mg/kg morphine p.o. and tested for analgesic tolerance on day 8. The antinociceptive effect of the combination was decreased after 8 days, indicating that tolerance may develop to the combination itself. However, these animals did not show tolerance to the morphine component of this combination, suggesting that a combination of low doses of THC and morphine may be able to prevent morphine tolerance. These findings may be clinically useful for patients with chronic pain, as the combination can be effectively administered in patients treated previously with morphine; this would allow reduction of morphine doses and alleviation of side effects which accompany high opioid doses in pain therapy. Supported by NIDA Grants DA07027, DA05274 and K02-DA00186.

CD44 DEFICIENT THYMOCYTES SHOW RESISTANCE TO APOPTOSIS WHEN CULTURED *IN VITRO*. J. G. Davidson, M. Nagarkatti¹, P.S. Nagarkatti². Department of Biology¹, and Department of Biomedical Sciences and Pathobiology², Virginia-Maryland College of Veterinary Medicine, VT. CD44 is a transmembrane glycoprotein expressed on a wide variety of cells including lymphocytes. Its principal ligand is hyaluronic acid which is found in the extracellular matrix. CD44 has been shown to be important in lymphocyte homing, adhesion, and as an alternate pathway for CTL activation. Recent studies from our lab demonstrated that CD44 was upregulated in cells which undergo apoptosis. In the current study we tested the hypothesis that CD44 may be involved in the induction of apoptosis. To this end, thymocytes from CD44 deficient mice were cultured *in vitro* and compared to those from wild-type mice. After both 12 and 24 hours of culture in medium alone, the CD44 deficient cells showed a clear resistance to spontaneous apoptosis which was detected using the TUNNEL method. Since radiation has been shown to induce apoptosis, both CD44 deficient and wild-type thymocytes were irradiated and cultured for 12 and 24 hours. Both groups of thymocytes showed increased levels of apoptosis when compared to cells cultured in medium alone. However, the CD44 deficient cells were more resistant to the induction of apoptosis. Similar results were obtained with dexamethasone induced apoptosis. Because CD44 is upregulated following T cell activation, it may play an important role in the apoptosis of activated T cells. Supported in part by grants from NIH [AI101392 and HL58541]

ROLE OF CD44 AND FAS IN THE DEVELOPMENT OF AUTOIMMUNE DISEASE Yoonkyung Do¹, Mitzi Nagarkatti², and Prakash Nagarkatti¹. ¹Department of Biology, and ²Department of Biomedical sciences and Pathology, Virginia-Maryland College of Veterinary Medicine, Virginia Tech, Blacksburg VA 24061. MRL-*lpr/lpr* mice which have defects in the expression of Fas gene, develop severe lymphoproliferative disease and are more susceptible to malignancies. The massive lymphadenopathy is due to the accumulation of B220⁺CD4⁺CD8⁻ (double negative, DN) T cells that bear unusual phenotype by expressing high densities of many markers including CD44. Recent studies from our laboratory demonstrated that CD44 might play a role in the induction of apoptosis. In the current study, therefore, we generated mice that were deficient in CD44 and Fas, and investigated the effect on the development lymphoproliferative disease. The data demonstrated that *CD44^{-/-}Fas^{-/-}* mice developed lymphoproliferative disease much earlier than *CD44^{-/-}Fas^{+/+}* mice. The early onset of disease in *CD44^{-/-}Fas^{+/+}* mice was also evident from increased presence of B220⁺CD4⁺CD8⁻ T cells and decreased presence of CD4⁺ and CD8⁺ T cells. These data demonstrated that CD44 plays an important role in the induction of apoptosis and that a defect in CD44 expression can lead to an early onset of lymphoproliferative disease. (Supported in part by grants from NIH, AI 01392 and HL 58641).

trans-RESVERATROL: A NATURAL PHYTOESTROGEN THAT INHIBITS CALCIUM INFLUX IN THROMBIN STIMULATED PLATELETS. Yuliya Dobryднеva, Roy L. Williams and Peter F. Blackmore*, Dept. of Chemistry and Biochemistry, Old Dominion and Dept. Physiological Sciences, Eastern Virginia Medical School, Norfolk VA. The stilbene *trans-resveratrol* (TR), which is found in grapes, has been shown to inhibit platelet aggregation and hence reduce the risk of thrombosis. The mechanism by which TR produces this effect is not known, since platelet aggregation can be activated by increasing intracellular free calcium ($[Ca^{2+}]_i$) we have explored the role TR has in regulating $[Ca^{2+}]_i$ in platelets. TR produced a dose dependent inhibition of thrombin to increase $[Ca^{2+}]_i$ with the IC₅₀ being 0.5 μM, which is the same for the inhibition of Ba²⁺ ion influx into platelets. TR was also able to inhibit thapsigargin induced increase in $[Ca^{2+}]_i$. This result implies that TR was able to inhibit store operated calcium channels. Several other phytoestrogens (e.g. genistein, genistein-glucoside, daidzein and apigenin) were examined, they also inhibited thrombin and thapsigargin induced elevations in $[Ca^{2+}]_i$. We hypothesize that phytoestrogens are able to block calcium influx through store operated calcium channels in platelets, thus accounting for their ability to inhibit aggregation. (Supported by AHA and Virginia Academy of Science).

LOBELINE: FAILURE TO MEET SHERIDAN PHARMACOPHORE REQUIREMENTS. D. D. Flammia[†], M. Dukat[†], M. I. Damaj[‡], B. R. Martin[‡], R. A. Glennon^{†‡}. [†]Departments of Medicinal Chemistry and [‡]Pharmacology and Toxicology, Virginia Commonwealth University, Richmond, VA 23298. Lobeline, a naturally occurring alkaloid with high affinity for the central nicotinic receptors, is structurally distinct from classical nicotinic receptor ligands. A structure-affinity study of lobeline has been undertaken in an attempt to define the features that are necessary for its high affinity (K_i = 4.4 nM). Previously defined nicotinic pharmacophores, such as the Sheridan model, suggest that the ketonic oxygen and the nitrogen atom define lobeline's pharmacophore. However, molecular modeling studies show that either oxygen atom can fit into previously defined nicotine receptor pharmacophore models.



This provided the rationale for synthesizing various analogs of lobeline in an attempt to identify a new pharmacophore. Lobeline hemi-analogs, abbreviated analogs possessing only one of the two oxygen atoms, and analogs with the oxygen functions in different oxidation states, indicate that both oxygen atoms of lobeline contribute to its high affinity.

OXIDATIVE STRESS AND TNF α STIMULATE TRANSENDOTHELIAL MIGRATION OF NEUTROPHILS. A.L. Goudevar, S.W. Walsh, B.J. Fisher*, A.A. Fowler, III*. Depts. OB/GYN, Phys., Internal Med., Va. Commonwealth Univ., Richmond, VA 23298. In preeclampsia, elevated levels of lipid peroxides and TNF α in the maternal circulation could activate endothelial cells to release IL-8, a chemotactic agent, which could attract neutrophils to migrate across the endothelial cells to the underlying vascular smooth muscle. In the following study we tested the hypothesis that oxidized fatty acids, as well as TNF α , would activate endothelial cells to produce IL-8 resulting in neutrophil migration. ECV-304 endothelial cells were seeded onto Transwell inserts at 20,000 cells/insert in M199 with 10% heat inactivated FBS. Cells were exposed to the following treatments for 4 hrs, then washed: 1) control M199; 2) linoleic acid (LA, 90 μ M); 3) oxidized linoleic acid (OxLA, 90 μ M); 4) OxLA plus TNF α (2 ng/ml); 5) TNF α (2 ng/ml); 6) TNF α (10 ng/ml). Neutrophils were isolated from heparinized blood from pregnant patients (n=8), labeled with 51 Cr for 1 hr, and added to the treated inserts, and assayed after two hrs. OxLA stimulated ECV-304 cells to produce IL-8. Both OxLA and TNF α induced transendothelial migration of neutrophils as compared to the M199 and LA. **Conclusions:** 1) OxLA stimulates endothelial production of IL-8; 2) OxLA induces transendothelial migration of neutrophils similar to that of TNF α . Therefore, in preeclampsia, endothelial cell activation by circulating lipid peroxides and TNF α could result in transendothelial migration of neutrophils that are producing TNF α and thromboxane. This could cause endothelial and vascular smooth muscle cell dysfunction resulting in vasoconstriction. HD20973

ALTERATION IN INOSITOL PHOSPHATES AFTER TRAUMATIC INJURY OF ASTROCYTES. C.L. Floyd, B.A. Rzigalinski, H.A. Sitterding*, K.A. Willoughby*, and E.F. Ellis*. Depts. of Psyc. and Pharm./Tox., Va. Commonwealth Univ., Richmond, Va. 23298. Our previous work has shown that *in vitro* stretch injury of cortical astrocytes causes a rapid elevation in intracellular free calcium ($[Ca^{2+}]_i$) which returns to normal by 15 minutes post-injury, and that intracellular Ca^{2+} stores are uncoupled from signal transduction events (J. Neurochem 70:2377). Consistent with uncoupled Ca^{2+} signaling, we have also shown that inositol polyphosphate (IP_x) levels are elevated 10 fold at 15 and 30 minutes post-injury when $[Ca^{2+}]_i$ has returned to normal (J. Neurotrauma 15:869). We tested the hypothesis that IP_x production after injury occurs through activation of metabotropic glutamate receptors (mGluR) coupled to phospholipase C (PLC). Cortical astrocytes grown on silastic membranes were pre-labeled with 3H -myo-inositol. Cells were treated before injury with either the PLC inhibitor neomycin sulfate or a mGluR group 1 antagonist. Cells and media were acid extracted and IP_x isolated using anion exchange. Pretreatment with neomycin sulfate (100 μ M) for 25 minutes and 3 hours produced a 48% and 98% inhibition of injury-induced-increases in IP_x , respectively. Pretreatment with group 1 mGluR antagonists (RS)-1-Aminoindan-1,5-dicarboxylic acid (AIDA), (S)-4-Carboxy-3-hydroxy-phenylglycine (S-4C3HPG), and 7-(Hydroxyimino) cyclopropano- [b] chromen-1a-carboxylate ethyl ester (CPCCOEt) produced 90%, 81% and 26% inhibition of injury-induced increases in IP_x , respectively. In summary, we found that astrocytes release inositol polyphosphates and that constitutive activation of PLC coupled to group 1 mGluRs produces the elevations in IP_x observed after injury. Thus, post-traumatic alteration in IP_x could affect intra- and intercellular signaling and have major consequences in injured brain. Supported by NS07288 & 27214.

ROLE OF APOPTOSIS IN 2,3,7,8-TETRACHLORODIBENZO-*P*-DIOXIN (TCDD)-INDUCED IMMUNOTOXICITY FOLLOWING PERINATAL EXPOSURE. L. M. Hudson¹, M. Nagarkatti², and P. S. Nagarkatti¹, ¹Departments of Biology and ²Biomedical Sciences and Pathobiology, Virginia-Maryland Regional College of Veterinary Medicine, Virginia Tech. TCDD, an environmental contaminant formed in as a byproduct in the manufacture of products from chlorinated phenols or during combustion of chlorinated materials, is considered to be the most biologically potent of the halogenated aromatic hydrocarbons (HAH). Studies from our lab have shown that TCDD induces thymic atrophy in C57BL/6 wild type adult mice, and this atrophy is mediated by apoptosis. Studies have also shown that the fetus is more susceptible to TCDD-induced toxicity. In the current study, we addressed the role of apoptosis in TCDD-induced toxicity in perinatally-exposed neonates. The pregnant mothers were treated with .1, 1, 5, or 10 μ g/kg body weight TCDD or the vehicle control via a single intraperitoneal injection on gestational day 14. The thymocytes of the pups were isolated on days 2, 4, 7, and 14 and studied for apoptosis. Other organs were studied for histological changes. We found that the thymic cellularity and percent thymocyte viability was decreased after TCDD treatment. We also found that the percent apoptosis in the TCDD-treated thymocytes after 24-hour *in vitro* culture was significantly increased. Together, these data indicate that apoptosis plays an important role in TCDD-induced toxicity in perinatally-exposed neonates. (Supported in part by grants from EPA and NIH).

NOVEL COCKROACH ANTIGEN IS PRESENT IN ALZHEIMER'S DISEASE AND OTHER NEURODEGENERATIVE DISEASES. Gary D. Isaacs, Heather Foley, and David A. DeWitt, Dept. of Biology and Chemistry, Liberty Univ., Lynchburg, VA 24502.

Alzheimer's disease is characterized by the presence of two lesions: intracellular neurofibrillary tangles and extracellular senile plaques. Over 40 different protein components have been found associated with these lesions in Alzheimer's disease. Many of these while initially described immunocytochemically have led to extensive research to identify potential causes of the disease. We found a novel antigen, 10-5A9, which is present in both the plaques and tangles. This is unusual because the monoclonal antibody that recognizes the antigen was initially raised to adult cockroach nervous system. In addition to the presence of 10-5A9 in Alzheimer's lesions, results indicate the antigen is also present in both the neuronal inclusions of Parkinson's disease, and diffuse Lewy body disease. Such localization of an antigen could indicate a possible role in inclusion formation in general or disease pathogenesis. Initial attempts to characterize and purify the antigen were thwarted by the tight association of the antigen to the lesions. The antigen remained associated with isolated plaques even following treatment with SDS. These results suggest that the 10-5A9 antigen is an integral component of these lesions. The authors thank G.P. for tissue and J.D. for antibody development.

THE ROLE OF SEVERAL KINASES IN MICE TOLERANT TO Δ^9 -TETRAHYDROCANNABINOL. Matthew C. Lee, David Stevens*, Sandra Welch, Dept. of Pharm/tox., Va. Commonwealth Univ., Richmond, Va. It has been suggested that the CB1 G-protein-coupled receptor is internalized following agonist binding and activation of the second messenger pathways. The process of desensitization and resensitization is intimately involved with receptor internalization. Phosphorylation alters tolerance to cannabinoids thus contributing to tolerance. It is proposed that phosphorylation enhances the down-regulation of the CB1 receptor. These findings led us to look at which kinase(s) may be involved in cannabinoid tolerance. We therefore hypothesize that by preventing phosphorylation of the CB1 receptor, we may reverse tolerance. We evaluated our hypothesis by inhibiting several kinases that may be involved in tolerance: protein kinase A (PKA), protein kinase C (PKC), protein kinase G (PKG), Beta Adrenergic Receptor Kinase (β -ARK), Phosphatidylinositol 3-kinase (PI3K) and the src family tyrosine kinase. We also looked at cAMP and cGMP analogs for possible tolerance potentiation. ICR mice were rendered tolerant to Δ^9 -tetrahydrocannabinol (THC). Antinociception was measured by the tail-flick test. %MPE's and ED50's were calculated. The inhibition of PKG, PKC, β -ARK and PI3-K showed no significant change in the %MPE in the tolerant mice treated with the inhibitor compared to the mice treated with vehicle. Even though the inhibition of PKC had no effect on tolerance, at a higher dose it attenuated the antinociceptive effect of THC in non-tolerant mice. The src family tyrosine kinase inhibitor, reversed tolerance. The PKA inhibitor reversed THC tolerance. These data support a role for PKA and tyrosine kinase in phosphorylation events in THC tolerant mice. (Supported by NIDA grants K02DA00186 and P50DA05274).

NEONATAL PHYTOESTROGEN EXPOSURE AFFECTS POST-PUBERTAL SPERM PRODUCTION IN MICE. Roman J. Miller and Jamey Groff,* Dept. of Biol., Eastern Mennonite Univ., Harrisonburg, Va. 22802. In a preliminary study, experimental groups of neonatal Swiss-Webster mice were injected subcutaneously on postnatal days 2, 4, 6, 8, and 10 with 100 μ g/50 μ l/day of one of three phytoestrogens--biochanin A, coumestrol, or diadzein. Controls were injected with 50 μ l of sunflower oil, which was used as the solvent for the phytoestrogens. Mice were killed on postnatal day 40 at which time body and testis weights were determined. Sperm quantification was done by homogenizing testes in a solution of 5% Triton X-100 made in saline and then counting sperm heads on a hemocytometer counting chamber. Neither body weights, testis weights, nor total sperm concentrations of mice in the biochanin A group significantly differed from the control mice. Body weights of the coumestrol and diadzein groups were significantly greater than controls (28.5 g & 29.3 g versus 22.6 g, respectively). Testis weights of the coumestrol and diadzein groups were significantly greater than controls (173 mg & 176 mg versus 137 mg, respectively). Tissue concentrations of sperm (#sperm/mg testis tissue) did not differ between experimental groups and the control, however total sperm counts (#sperm/testis) were significantly greater in coumestrol and diadzein mice than in controls (498,000 & 535,500 versus 411,700). Based on our results, coumestrol and diadzein enhance body and testis growth and thereby increase postpubertal total sperm counts in neonatally treated mice.

NATURALLY OCCURRING PHYTOESTROGENS AND APOPTOSIS IN HUMAN CANCER CELLS. Gary Morris*, Roy L. Williams, Mark Elliott, Dept. of Chem./Biochem., Old Dominion University, Norfolk, VA 23508 and Stephen Beebe, Center for Pediatric Research, Children's Hospital of the King's Daughters, EVMS, Norfolk, VA. Trans-resveratrol (TR) is a phytoalexin produced by a variety of plants including grapes. There has been considerable interest in the scientific community in TR because it is present in products consumed on a daily basis. TR has been shown to have a variety of biological activities in cultured human cell lines, one of which is its ability to interact with the estrogen receptors (ER) of hormone sensitive breast cancer cells lines. TR is structurally similar to diethylstilbesterol (DES) which is a known superestrogen capable of exhibiting toxicity to human prostate cells (LNCaP). Although DES and TR are structurally similar, the present study demonstrates that TR is able to induce apoptosis in LNCaP cells, while DES appears to induce necrotic cell death in this same cell line.

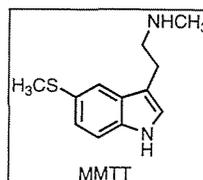
PACLITAXEL RECONSTITUTES MACROPHAGE INTERLEUKIN-12 PRODUCTION IN TUMOR-BEARING HOSTS THROUGH NITRIC OXIDE. David W. Mullins¹, Carol J. Burger, and Klaus D. Elgert. Dept. of Biology, Microbiology and Immunology Section, Virginia Tech, Blacksburg, VA 24061-0406. Tumor-induced macrophages (Mφs) mediate immunosuppression, in part, through underproduction of positive regulatory cytokines that normally promote T-cell-mediated responses. The anticancer agent paclitaxel (Taxol™) partially reverses tumor-induced Mφ suppressor activity, suggesting that paclitaxel may restore tumor-bearing host (TBH) Mφ production of proimmune factors. We investigated whether paclitaxel induces Mφ interleukin-12 (IL-12) production. Tumor growth significantly downregulated Mφ production of bioactive IL-12 (p70) through selective dysregulation of the IL-12 heavy (p40) chain. Paclitaxel significantly increased both normal host and TBH Mφ IL-12 p70 production, which relieved tumor-induced Mφ suppression of T-cell alloreactivity. Blocking Mφ nitric oxide (NO) suppressed paclitaxel's ability to induce IL-12 production, suggesting those paclitaxel-induced activities involve a NO-mediated autocrine induction pathway. Through its capacity to induce IL-12 production, paclitaxel may contribute to the correction of tumor-induced immune dysfunction.

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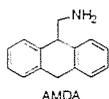
HYALURONAN LEVELS IN NORMAL HUMAN SKIN DURING WOUND REPAIR. Naem Poursharif, Steve J. Montante*, and Dorne R. Yager*, Laboratory of Tissue Repair, Med. College of Virginia Campus of Virginia Commonwealth Univ., Richmond, Va. 23298. The purpose of this study was to quantitatively compare hyaluronan levels in full-thickness incisional human wounds during repair. Hyaluronan was extracted from incisional wounds at different times post wounding. Levels were determined using a radiometric assay. Results indicate an increase in levels of hyaluronan during days 1 and 2 post wounding. This may have implications for the role of hyaluronan in migration of cells involved in repair of wound sites.

DEVELOPMENT OF NOVEL 5-HT_{1D} SEROTONERGIC AGENTS. T. Prisinzano,¹ H. Law,^{1*} M. Dukat,¹ D. K. H. Lee,^{2*} R. A. Glennon¹. ¹Department of Medicinal Chemistry, Virginia Commonwealth University, Richmond, VA 23298 and ²Allelix Biopharmaceuticals, Toronto, Canada. Development of the serotonin (5-HT) receptor agonist sumatriptan has proven to be a significant advance in the treatment of acute migraine. It is generally accepted that its clinical efficacy is mediated through its action at either h5-HT_{1B} or h5-HT_{1D} receptors for which it shows no selectivity. Despite its clinical effectiveness, sumatriptan has a potential for coronary artery constriction and is contraindicated in patients with heart disorders. This is thought to result from its affinity for h5-HT_{1B} receptors. Compounds selective for h5-HT_{1D} receptors might represent a new generation of migraine therapy. We have used a 2-benzylimidazoline template to develop novel h5-HT_{1D} selective agents and have now identified several imidazolines, imidazoles, and related derivatives with enhanced affinity. ALX-1452, for example, binds at h5-HT_{1D} receptors with high affinity (K_i 35 nM) and greater than 125-fold selectivity over h5-HT_{1B} receptors.

5-HT₆ RECEPTORS: THE FIRST SYSTEMATIC SAR STUDY. J. Rangisetty,¹ M. Lee,^{1*} M. Dukat,¹ M. Bondarev,¹ B. Roth,² and R. A. Glennon,¹ ¹Department of Medicinal Chemistry, Virginia Commonwealth University, Richmond, VA 23298 and ²Case Western Reserve University, Cleveland, OH. 5-HT₆ receptors represent one of the newest populations of the serotonin receptor family. Several antipsychotic and antidepressant agents bind with high affinity to these receptors suggesting that this population of receptors may play role in neuropsychiatric disorders. Very little is known about the structural requirements for binding at 5-HT₆ receptors. As a prelude to design of 5-HT₆ ligands, we systematically investigated the structure affinity relationships for the binding of indolealkylamines. Beginning with 5-HT itself (5-HT₆ K_i = 75nM), we examined the contribution to binding of (a) the 5-position hydroxyl group, (b) aromatic methoxy substitution, (c) terminal amine substitution, (d) side chain lengthening, branching, and conformational restriction, and (e) the pyrrole ring. The structure-activity data were subsequently applied to the development of N-methyl-5-methylthiotryptamine (MMTT, K_i = 3nM) which binds at 5-HT₆ receptors with 25 fold higher affinity than 5-HT.



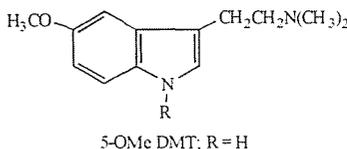
RECEPTOR STRUCTURE BASED DESIGN OF NOVEL 5-HT_{2A} LIGANDS. S.P. Runyon,¹ M.L. Bondarev,¹ B.L. Roth,^{2*} R.A. Glennon,¹ R.B. Westkaemper,¹ ¹Department of Medicinal Chemistry, Virginia Commonwealth University, Richmond, VA. 23298-0540 ²Departments of Psychiatry, Biochemistry and Neurosciences, Case Western Reserve University, Cleveland, OH. 44106-4935. Serotonin₂ (5-HT₂) receptors are involved in mediating a wide variety of physiological functions throughout the body including smooth muscle contraction, platelet aggregation, modulation of perception, mood, and anxiety. Unfortunately, very little is known about the precise three-dimensional structure of these membrane bound neurotransmitter receptors. Consideration of hypothetical three-dimensional receptor models along with site-directed mutagenesis data has led to the synthesis of 9-aminomethyl-9,10-dihydroanthracene (AMDA) as a potent 5-HT_{2A} antagonist. The high affinity of AMDA (K_i=20 nM) is unique in that it does not conform to the established structure activity relationships for 5-HT_{2A} receptors. Several analogs of AMDA have been synthesized including alteration of the central ring size, introduction of a methano or ethano bridge and a series of 2,2-diphenylethylamines. From these modifications it appears that the high affinity in the series is related to geometric parameters describing the relationship between the two aromatic rings and the distance of the amine atom above the aromatic ring. (This work supported by U.S. Public Health Service Grant MH57969RBW)



PHENYLALKYLAMINES: NOT JUST 5-HT₂ AGONISTS. C.L. Schieck,¹ M. Teitler,^{2*} R.A. Glennon,¹ ¹Department of Medicinal Chemistry, School of Pharmacy, Virginia Commonwealth University, Richmond, VA 23298 and ²Department of Pharmacology and Toxicology, Albany Medical College, Albany, NY 12208. Serotonin 5-HT₂ receptors are thought to play a role in a variety of physiological events, including anxiety, depression, and schizophrenia. There are several classes of small molecules that bind to these receptors, allowing investigation into their functions. One class of ligands, the phenylalkylamines, has high affinity and selectivity for 5-HT₂ receptors. These molecules typically behave as 5-HT₂ agonists and are thought to bind to the receptor in an area termed "Site 1." Structurally different molecules, acting as 5-HT₂ antagonists, are thought to bind in "Site 2." We recently identified DOPP, a phenylalkylamine antagonist. Analogs of DOPP have been made and examined at 5-HT₂ receptors. The binding results show there are different structure-activity relationships that exist for phenylalkylamine agonists versus antagonists. Furthermore, binding results of DOPP at mutant 5-HT₂ receptors show that these compounds may not occupy either Site 1 or Site 2 in the same manner as agonists or non-phenylalkylamine antagonists. It may be that this class of compounds is binding to 5-HT₂ receptors differently than either structurally-related or functionally-related ligands. Together, these studies provide evidence that DOPP and its analogs represent a new class of 5-HT₂ ligands: the phenylalkylamine antagonists.

IS BUPROPION A NON-COMPETITIVE NICOTINIC ANTAGONIST? J. E. Slemmer, B. R. Martin, and M. I. Damaj. Dept. of Pharmacology and Toxicology, Med. Col. of Virginia, Virginia Commonwealth Univ., Richmond, VA 23298. Bupropion, an atypical antidepressant (Wellbutrin®), is currently also prescribed as part of a smoking cessation therapy (Zyban®). Recently, we reported that bupropion blocked nicotine's pharmacological effects in various behavioral tests. In order to further characterize the action of bupropion on neuronal acetylcholine receptors (nAChRs), electrophysiological studies were conducted using *Xenopus* oocytes injected with nAChR mRNA of three different subtypes: $\alpha 4\beta 2$, $\alpha 3\beta 2$, and $\alpha 7$. Bupropion alone elicited no effect; however, it did block the effect of acetylcholine (ACh) in a concentration-dependent manner. IC_{50} values (concentrations that inhibited 50% of ACh's effect) for $\alpha 4\beta 2$, $\alpha 3\beta 2$, and $\alpha 7$ subtypes were found to be 8, 1.3, and 60 μM , respectively. The preapplication of bupropion enhanced its sensitivity to nAChRs, indicating that it may interact with the closed state of the channel. Bupropion's blockade of ACh was found to be voltage-independent. In addition, bupropion at 10 μM was unable to compete for [3H]-nicotine binding sites (largely $\alpha 4\beta 2$ subunits) in rat brain. It is thus proposed that bupropion is a non-competitive nicotinic antagonist. The differential sensitivity of bupropion to nAChRs may indicate that the localization of the subtypes in various brain regions could account for its effectiveness as a smoking cessation aid. (Supported by NIH DA-05274.)

EXPLORATION OF NOVEL 5-HT₆ SEROTONIN LIGANDS. Y. Tsai,¹ M. Lee,^{1*} J. B. Rangisetty,¹ D. K. H. Lee,^{2*} M. Dukat,¹ R. A. Glennon.¹ ¹Department of Medicinal Chemistry, Virginia Commonwealth University, Richmond, VA 23298 and ²Allelix Biopharmaceuticals, Toronto, Canada. To date, 14 distinct types of mammalian serotonin (5-HT) receptors have been identified; one of the most recent members is the 5-HT₆ population. The most remarkable pharmacological feature of this receptor is its high affinity for antipsychotic and tricyclic antidepressant drugs. Even given the large number of agents that has been examined, it has been difficult to formulate structure-affinity relationships due to their structural diversity. We have initiated a structure-affinity study with 5-HT (K_i = 75 nM) and a related tryptamine, 5-OMe DMT (K_i = 78 nM), as templates. Simple N₁-substitution of 5-OMe DMT significantly decreases 5-HT₆ receptor affinity. However, with the appropriate substituents, affinity can be increased to about 1 or 2 nM. The influence of electronic and steric parameters was also examined. N₁-substituted derivatives of tryptamines represent a novel class of high-affinity 5-HT₆ ligands.



REPRODUCTIVE EXPERIENCE MAY MODIFY STRESS RESPONSIVENESS IN THE FEMALE RAT. Wartella, J.E., Amory, E.A., Plozsay, A.*, Belinsky, E.*, Lambert, K.G. & Kinsley, C.H. Department of Psychology, University of Richmond, Va 23173; and ¹Department of Psychology, Randolph-Macon College, Ashland, VA 23005. In such variables as brain complexity, which includes hippocampal and anterior hypothalamic areas and such structures as neurons and glia, the brain of a primi/multiparous female (PRIM or MULT, respectively) is significantly modified compared to a nulliparous (NULL) female. In recent work from our laboratory involving testing NULLs and MULTs in a radial arm maze, we observed that multiparous females were much less fearful when first placed in the maze. The latter group moved about and actively investigated the arms, whereas the NULLs generally froze and appeared overly reactive. To follow up neurally, a group of NULL females were brought into the laboratory and randomly divided into three groups. Two of the groups were mated to produce PRIMs and MULTs. Two weeks following the weaning of their second six-pup litter, the MULTs and age-matched PRIMs and the non-pup-exposed NULLs, were subjected to a 60-min. restraint stress paradigm (enclosure in a Plexiglas restraint tube). All animals were then anesthetized and perfused with paraformaldehyde, the brains removed, and processed for c-fos immunoreactivity (IR) in CA-3 region of the hippocampus and in the amygdala. MULTs and PRIMs had very similar numbers of c-fos-IR neurons in both hippocampus and amygdala, whereas both were lower than NULLs. These data suggest that reproductive (viz., hormonal) and/or maternal (viz., pup exposure) experience may inure a female and her brain to stress, rendering her less susceptible to the behavioral – or other – disruptions that stress sensitivity can produce.

CALCIUM-MEDIATED SIGNAL TRANSDUCTION IS ALTERED AFTER TRAUMATIC INJURY OF CORTICAL NEURONS. J.T. Weber, B.A. Rzigalinski, K.A. Willoughby, & E.F. Ellis. Dept. of Pharmacology and Toxicology, Medical College of Virginia Commonwealth Univ., Richmond, VA 23298. Calcium influx, and a corresponding elevation of intracellular free calcium ($[Ca^{2+}]_i$), is hypothesized to cause cell injury and death after traumatic brain injury. Using an *in vitro* model for traumatic injury, we have previously shown that $[Ca^{2+}]_i$ is rapidly elevated after mild-moderate stretch injury of cortical neurons, however $[Ca^{2+}]_i$ returns to basal levels by 3 hr post-injury. Therefore, we investigated the hypothesis that receptor-mediated increases in $[Ca^{2+}]_i$ are altered after stretch injury of neurons using fura-2 microspectrophotometry. Elevation of $[Ca^{2+}]_i$ in response to glutamate and NMDA was enhanced 15 min after injury. Glutamate-induced $[Ca^{2+}]_i$ elevation remained enhanced through 24 hr after injury, but the response to NMDA was normal by 3 hr post-injury. Elevation of $[Ca^{2+}]_i$ in response to the metabotropic glutamate receptor agonist, trans-(1S,3R)-1-Amino-1,3-cyclopentanedicarboxylic acid (tACPD), or the smooth endoplasmic reticulum Ca^{2+} -ATPase inhibitor, thapsigargin, was abolished 15 min after injury, suggesting that intracellular calcium stores were empty or damaged. Three hr after injury responses to tACPD and thapsigargin were potentiated, suggesting that intracellular calcium stores became hyper-responsive. We hypothesize that changes in calcium-mediated cellular signaling and intracellular calcium stores, rather than a sustained elevation of $[Ca^{2+}]_i$, may contribute to the pathology that is observed after traumatic brain injury.

AN INVESTIGATION OF *MUSA* POLYPHENOLOXIDASES. Amy Wilkerson, J. Haliburton, and H. Alan Rowe, Department of Chemistry/Center for Materials Research, Norfolk State University, Norfolk, Virginia 23504. Polyphenoloxidase (PPO) is known to exist in a variety of plants. Roots of several plants are known to release PPO into the rhizosphere and this enzyme may play a role in the resistance of these plants to xenobiotics. PPO has also been implicated in the degradation of pollutant phenols from chemical process streams. However knowledge of the structure of PPOs and the biochemistry of the reaction this enzyme catalyzes is still under investigation. PPO was isolated from different species of banana and kinetic studies conducted on the crude extract as well as the partially purified material. The enzyme purification scheme was optimized using selective precipitation, gel filtration chromatography, and buoyant density ultracentrifugation. The purified materials was also studied using ESR spectroscopy using a Bruker Instrument in the X- and Q-bands. This study was conducted as part of a joint project with the Department of Chemistry at the University of Kelaniya in Sri Lanka concerning the biochemistry of different banana species (Supported by CMR/DE-FG01-94EW11493).

EFFECTS OF A SELECTIVE SEROTONIN REUPTAKE INHIBITOR ON COGNITIVE PERFORMANCE FOLLOWING EXPERIMENTAL TRAUMATIC BRAIN INJURY. Margaret S. Wilson, R. J. Hamm*, S. M. DeFord, C. J. Gibson*, & D. Buck*, Dept. of Psychology/Div of Neurosurgery, Va. Commonwealth Univ., Richmond, VA 23298-0693. Serotonin plays a pertinent role in the pathobiology of traumatic brain injury (TBI). Dietrich et al. (1997) reported increased extracellular serotonin levels following fluid-percussion injury in rats. Injury-induced learning/memory deficits may be mediated by serotonin, as 5-HT₃ antagonist (Ondansetron) attenuated scopolamine-induced spatial learning impairment (Carli et al., 1997). Also, Fluoxetine facilitated functional recovery following stroke (Dam et al., 1996). The current study examined the effects of chronic administration of a selective serotonin reuptake inhibitor (SSRI) on post-TBI cognitive performance. Rats received moderate lateral fluid percussive injury 24hrs after surgical preparation. The SSRI was administered chronically (0mg/kg, 2.5mg/kg, 5.0mg/kg, 10.0mg/kg) on post-injury days (PID) 1-15. Motor performance was assessed PID 1-5 and Morris Water Maze (MWM) performance was assessed PID 11-15. No significant difference was found between groups for MWM performance. These results indicate that chronic SSRI administration has no effect on recovery of cognitive function following lateral fluid-percussive injury.

MICROSCOPIC ANALYSIS OF THE IN VITRO AND IN VIVO EFFECTS OF THE ANTISENSE OLIGONUCLEOTIDE, ISIS 2105, ON CORNEAL EPITHELIUM AND ENDOTHELIAL D.L. Yarbrough¹, J.C. Davidson², P.B. Williams³, and J.D. Sheppard⁴, ¹Dept of Biology, ODU, and ²Dept. of Physiological Sciences, EVMS, Norfolk, VA. Rejection of corneal transplants follows immune recognition of intercellular adhesion molecules (ICAMS) expressed on the endothelial surface of the donated cornea. Leukocytes bind to ICAMS, infiltrate the graft, cause deterioration and rejection of the donated cornea. ISIS 2105, an antisense oligonucleotide, inhibits ICAM expression. The objective of this study is to evaluate the potential of ISIS 2105 for the prevention of corneal transplant rejection. METHODS: Dose-related toxicity of ISIS 2105 (40-400 µg/ml) was studied in vitro (Exp#1) and in vivo (Exp#2). In Exp#1 human corneas were stored in ISIS 2105 and evaluated by specular microscopy. In Exp#2 ISIS 2105 was applied topically in the rabbit eye 4x/d. They were examined daily using the MacDonald-Shadduck Ocular Toxicity Scale. In both exp. corneas were removed after 8 days and prepared for light and scanning electron microscopy (SEM). RESULTS: In Exp#1 ISIS did not decrease the number of endothelial cells. Uptake of ISIS into the cornea was dose dependent. Upon SEM heavy epithelial exfoliation and endothelial pitting and enucleation were observed to be consistent in both vehicle-treated control and ISIS-treated groups. In Exp#2 the MacDonald-Shadduck Ocular Toxicity scale noted slight conjunctival erythema and chemosis consistent with that observed with vehicle alone. Corneal opacity was minimal and dose dependent. Upon SEM both epithelial and endothelial integrity were preserved in all groups. CONCLUSION: ISIS 2105 is not toxic to stored human corneas or corneas in vivo. ISIS 2105 could potentially be used in the prevention of corneal allograft rejection.

Natural History & Biodiversity

A STUDY OF ABRAMS CREEK-WHITE'S POND WETLANDS. Kara R. Barnes, Gregory J. Baruffi, Kimberly B. Bryant, Jennifer P. Keffer*, and Scott M. Vogel*, Dept. of Environmental Studies and Dept. of Biology, Shenandoah Univ., Winchester, Va. 22601. A study was conducted at the Abrams Creek-White's Pond Wetlands in Winchester and Frederick County, Va. This area encompasses a variety of habitats and land uses: agricultural practices, wetlands, rare plants, a creek, open space, nearby residential development, a pond, and impending road construction. Five students and their faculty advisor began the study in January 1998 to characterize the water quality and selected wetland communities within the research site. Water quality was characterized by testing physical, chemical, and biological properties of Abrams Creek in nine locations over four months. The water quality was characterized as unsatisfactory to good. Although the levels of some of the properties are acceptable, levels of other factors are considered unsatisfactory. Seven wetland communities were described using the relevé (Braun-Blanquet) plant community survey method. Plant species were categorized according to their percent cover as well as their rare or threatened status and global levels. The preliminary list of vascular plant species consists of approximately 145 species, including four new county records, nine species listed on the Va. Rare Plants List, and five species listed on the Va. Plant Watchlist. Analysis of the land uses throughout the research site and adjacent areas has helped the researchers identify possible threats to the area, as well as the consequences of these threats and reasonable recommendations.

FIVE SMALL MAMMAL GENERALISTS OF VIRGINIA'S COASTAL PLAIN: IS MICROHABITAT IMPORTANT TO THEIR LOCAL DISTRIBUTIONS? A. Scott Bellows & John F. Pagels, Dept. of Biology, VA Commonwealth Univ., Richmond, VA 23284, & Joseph C. Mitchell, Dept. of Biology, Univ. of Richmond, Richmond, VA 23173. A total of 1,064 small mammals represented by five generalist species, three soricid and two rodent species, was collected on Fort A. P. Hill using pitfall/drift fence and snap trap techniques. Using canonical correspondence analysis, we were able to determine 26.6% of the variation in the microhabitat distributions of five small mammal habitat generalists based on microhabitat variables we measured. We found that three variables had a strong influence on the local distributions of four generalists: diameter of downed-woody-debris (*Sorex hoyi*, *Blarina brevicauda*, *Microtus pinetorum*), shrub density (*Sorex longirostris*), and canopy closure (*Sorex hoyi*). We attribute the importance of these habitat variables to their contributions to local moisture and structure gradients. We attribute the lack of any association between measured variables and *Peromyscus leucopus* to this rodent's ability to obtain requirements from a wide variety of sources. We found no significant differences ($P < 0.05$) in both total captures and captures for each generalist among habitat types. We conclude that these generalists select for microhabitat components common to a wide range of habitat types. (Funding was provided by the Environmental and Natural Resources Division of Fort A. P. Hill and administered by the Fish and Wildlife Information Exchange

PARENTAGE AND SELECTION IN HATCHERY-RAISED AMERICAN SHAD, *Alosa sapidissima*, IN VIRGINIA. Charlene R. Couch¹, Jon M. Waters², John M. Epifanio³, Thomas P. Gunter, Jr.*⁴, & Bonnie L. Brown¹. ¹Dept. of Biol. Va. Commonwealth Univ., Richmond, Va. 23284, ²University of Otago, Dunedin, New Zealand, ³Trout Unlimited, Arlington, Va. 22209, ⁴Va. Dept. of Game and Inland Fisheries, Ashland, Va. 23005. We investigated conservation of genetic diversity during the hatchery phase of a restoration program for American shad (*Alosa sapidissima*) in Virginia (U.S.A.). Using five tri- and tetra-nucleotide microsatellite loci, we examined levels of reproductive variance and the potential for selection. Samples of broodstock (n=28) and hatchery progeny (n=415) collected over the spawning season exhibited high genetic diversity (broodstock: 37 alleles, $\bar{A}=9.4$, mean $H_E=0.79$, and $H_D=0.75$; progeny: 56 alleles, $\bar{A}=15.2$, mean $H_E=0.77$, and $H_D=0.76$). In one of three single-family studies (4 male X 4 female broodstock and 140 of their progeny), genetic analysis of parentage revealed that although each parent contributed, offspring were not uniformly distributed among parental pairs. This indicated that breeding procedures may result in high levels of reproductive variance for individual mass-spawned families. Nevertheless, across all three families examined, comparisons between broodstock and fry yielded no loss of alleles and no loss of genetic diversity. Furthermore, in a comparison of fry sampled at hatching (n=210, sampled on 3 occasions) versus their siblings sampled immediately prior to release from the hatchery (n=205), no loss of genetic diversity was detected, indicating that the potential for hatchery selection throughout the season was negligible. (Supported pursuant to award No. NA76FD017 to Virginia Commonwealth University by the National Oceanic and Atmospheric Administration under the Saltonstall-Kennedy grant program.)

GENETIC STRUCTURING IN RELICT POPULATIONS OF THE RED-BACKED VOLE, *Clethrionomys gapperi*, IN VIRGINIA. Charlene R. Couch, Bonnie L. Brown, and John F. Pagels, Dept. of Biol., Va. Commonwealth Univ., Richmond, Va. 23284, and Jonathan M. Waters*, Univ. of Otago, Dunedin, New Zealand. We investigated genetic variation in relict populations of the red-backed vole, *Clethrionomys gapperi*, using microsatellite DNA markers and related our results to the biogeographic history of the southern Appalachians. Genotypes were determined for 222 individuals at nine sites in Virginia. Overall genetic variation was moderate to high with $H_E=0.7$ and $\bar{A}=8$. Unbiased estimates of exact P-values revealed significant allelic differentiation between the majority (38 of 72) of the population pairs. Overall estimates of F_{ST} and rho were 0.07 and 0.10, respectively, indicating moderate genetic subdivision. Hierarchical tests of isolation by distance indicated a significant positive relationship between genetic distance and geographic distance within the Ridge and Valley physiographic province where 7 of 9 sites are located ($r^2=0.716$, $P<0.001$). Gene flow was estimated indirectly using three methods and produced congruent overall estimates that ranged from 1 to 4 migrants per generation. Hypothesized isolation of two island-like populations (presumably since the Wisconsin glacial retreat) was supported by this study and was most apparent in the Massanutten population where genetic diversity was low ($H_E=0.37$, $\bar{A}=4$) compared to all other populations. Genetic patterns observed in relict populations of the relatively common red-backed vole may provide insight into the genetic structuring of co-distributed rare boreal populations in the southern Appalachians.

A FLORISTIC CLASSIFICATION OF OAK FORESTS OF THE CENTRAL AND NORTHERN BLUE RIDGE MOUNTAINS OF VIRGINIA. Philip P. Coulling and Gary P. Fleming*, Virginia Department of Conservation and Recreation, Division of Natural Heritage, 217 Governor St. 3rd Floor, Richmond, VA 23219. The Virginia Department of Conservation and Recreation, Division of Natural Heritage (DCR-DNH) is currently developing a comprehensive, floristically based classification of the vegetation of Virginia. This system constitutes a prerequisite to the identification of significant examples of ecological communities and represents an essential step in furthering the Division's mission to conserve and protect the state's natural heritage resources. To illustrate the methodology envisioned for generating this classification, agglomerative, hierarchical cluster analysis was used to develop a classification of oak forests and woodlands in the central and northern Blue Ridge Mountains. Analysis was performed on 179 vegetation samples using the flexible-beta clustering strategy and Bray-Curtis dissimilarity computed from species cover data relativized by species maxima and sample totals. Four broad vegetation classes (High-Elevation Forests, Low-Elevation Forests, Oak-Heath Forests and Woodlands, and Chestnut Oak Woodlands) comprising 22 finer community types were recognized. Nominal species for the latter, finer units were chosen on the basis of frequency of occurrence within each vegetation type (constancy), specificity to a type (fidelity), and mean and relative abundance. Many of these vegetation types have not been described in the U.S. National Vegetation Classification; of particular note are *Quercus rubra* - *Carya* sp. forests that may be largely endemic to this region of the Blue Ridge. Ordination using non-metric multidimensional scaling revealed that soil fertility and elevation are the most important environmental gradients associated with variation in species composition.

ANT SPECIES DIVERSITY IN NATURAL AND CREATED WETLANDS. B.Shawn Everett & Deborah A. Waller, Dept. of Biol. Sci., Old Dominion Univ., Norfolk, Va.23529. The creation of artificial wetlands is used to mitigate losses of natural wetland habitat that result from human activity. It is crucial to know if these systems will function similarly to the areas they replace. This study examined ant diversity in three created and three natural wetland systems. Ants were collected from baits, litter samples, and vegetation sweeps. Comparisons in diversity were made between natural and created sites, and between the grassy middle and woody perimeter of each site. The natural sites were much more diverse than the created sites and the perimeters were much more diverse than the grassy areas they bordered.

IN SEARCH OF COASTAL PLAIN ABSENTEES OF THE YORK RIVER. Gregory G. Howard* and Werner Wieland, Dept. of Biological Sciences, Mary Washington College, Fredericksburg, VA 22401. The swamp darter, *Etheostoma fusiforme* is a small Coastal Plain fish, common from Maine to Florida and along the Gulf coast to the Mississippi River. In Virginia its historic distribution is peculiar due to the absence of this species from the Rappahannock and York river basins. Changes in sea level due to melting of continental glaciers have been suggested as a reason for its absence from the Coastal Plain of these drainages. Upon discovering the swamp darter in a student's collection from the Upper York River basin we searched for this species in additional tributaries. To date we have discovered a total of two populations in tributaries of the Mattaponi River. Both localities lie within the Coastal Plain physiographic province. Thus it is likely that additional populations exist and its apparent absence may be attributed to its rare occurrence in these streams and/or the difficulty of collecting in Coastal Plain streams. (Supported by Mary Washington College Undergraduate Research Grant Program)

CHARACTERISTICS OF WOODY DEBRIS IN BURNED AND UNBURNED LONGLEAF PINE FOREST. Janinne Hutson-Black & Deborah A. Waller, Biology Dept., Old Dominion Univ., Norfolk, Va. 23529. Longleaf pine forests are fire-maintained habitats that thrive when subjected to periodic burns. Woody debris on the forest floor may be consumed or superficially scorched by fire, and wood litter from dead trees and limbs may increase following burns. These changes may affect animals that depend on wood for food or shelter. We compared sites at the Blackwater Ecological Preserve that had been burned either three months, one year or two years previously with adjacent unburned sites by measuring logs intersecting 100 m transects for diameter, length and temperature. Fire had no effect on log length or diameter, but log temperature was significantly greater in burned sites.

SPECIES RECOGNITION FOR *PERCINA NEVISENSE* COPE

(ACTINOPTERYGII: PERCIDAE). Eugene G. Maurakis, Science Museum of VA, 2500 W. Broad St., Richmond, VA 23220 and Univ. Richmond, VA 23173, John T. Goodin,* Wetlands Div., U.S. EPA, 401 M St., SW, Washington, DC 20460, Elgin S. Perry,* 2000 Kings Landing Rd., Huntingtown, MD 20639, and William S. Woolcott, Biology Depart., Univ. Richmond, VA 23173. Analysis of character variation among populations of *Percina peltata* (shield darter) throughout its range indicates species-level differentiation between northern and southern populations. Populations in and south of the Chowan-Roanoke River drainage represent *Percina nevisense* (Neuse River darter). Populations in and north of the James River drainage represent *P. peltata*. These conclusions are supported by multivariate analyses of nine meristic (eight significant discriminators) and eight morphometric (seven significant discriminators) characters. Presence of cheek scales, the most prominent external discriminator in *P. nevisense*, scales above and below lateral line, scales around caudal peduncle, dorsal fin ray spines, dorsal fin pterygiophore position, and caudal peduncle depth can be used to distinguish *P. nevisense* from *P. peltata*.

FACTORS INFLUENCING THE SELECTION OF ANTS FOR FEEDING AND ANTING BEHAVIORS BY CAPTIVE SONGBIRDS. Hannah C. Revis, Dept. of Biol. Sci., Old Dominion Univ., Norfolk, Va. 23529.

Songbird/ant interactions can include both eating and anting displays by songbirds and ant defensive mechanisms, including biting/stinging, fast running and chemical secretions. Anting behavior with Formicine ants by songbirds is well documented and is thought to be performed by birds to remove chemical secretions of the ants. I have found that songbirds will also "ant" with non-stinging/biting Myrmicine ants. Choice trials using both Formicinae and Myrmicinae subfamilies were run at the Virginia Living Museum, Newport News, Va. Both *Aphaenogaster fulva* and *A. rudis* were selected for anting displays 43.7% of the time and were consumed 37.5% of the time they were made available to the captive songbirds. This selection of the fast running, non-aggressive Myrmicine contrast to the avoidance displayed by the songbirds towards *Crematogaster lineolata* and *Pheidole dentata*, both biting Myrmicine ants. Interactions between captive songbirds and ants differ with the ant type, not only between Formicinae and Myrmicinae subfamilies but also within the Myrmicinae genera.

OVOPOSITION SITES AND HABITATS OF 13-YEAR PERIODICAL CICADAS (BROOD XIX) IN EASTERN VIRGINIA. Heather F. Sahli and Stewart Ware, Col. of William and Mary, Dept. of Bio., Williamsburg, VA 23186.

In 1998, 13-year periodical cicadas (Brood XIX) emerged in the Coastal Plain of Virginia in western James City and adjacent eastern Charles City counties. This emergence is a considerable extension of known geographic range. While much research has been done on periodical cicadas, apparently no quantitative studies have been carried out to determine the vegetational structure of brood emergence sites or oviposition sites. We chose five stands which experienced high densities of emergence. In each stand, large tree and small tree densities and dominance were determined. In determining whether there was a preference for egg deposition in woodland edges versus the forest interior, one of these sites was studied. Paired observations were made at the edge of the forest and about 15 meters into the forest, recording the tree species and presence or absence of egg deposition. We also provide a list of all the tree species which exhibited evidence of egg deposition. We found that the canopies of emergence sites can be dominated by either pine (*Pinus taeda*), oak (*Quercus* spp.), sweetgum (*Liquidambar styraciflua*), beech (*Fagus grandifolia*), red maple (*Acer rubrum*), or holly (*Ilex opaca*). The large presence of pine canopies was particularly surprising due to the low hatching rates of eggs deposited in these highly resinous trees. This suggests that the periodical cicadas found a sufficient number of alternate host species in which to deposit their eggs, and that the roots of pine trees are capable of sustaining the cicada nymphs. We also found that Brood XIX showed a significant preference for depositing their eggs on twigs on forest edges rather than depositing on twigs in the forest interior.

GROWTH COMPARISON BETWEEN WINTER AND SPRING SOWN VIRGINIA LONGLEAF PINE. Philip Sheridan^{1,2}, Leif Jacobson¹, and Nancy Penick¹. ¹Meadowview Biol. Research Station, Woodford, VA and ²Dept. of Biol. Sciences, ODU. Longleaf pine, *Pinus palustris* Miller, is extremely rare in Virginia with only 4432 trees remaining. Since no commercial supplier of Virginia longleaf pine was available we collected seeds from a natural stand on Union Camp property in the City of Suffolk, Virginia in November 1997. Commercial propagation of longleaf pine in the southeast involves a May sowing with seedlings available for planting in the fall. Our goal was to determine whether winter sown seed (n = 1748) would result in a significantly greater proportion of adequately sized seedlings (measured by root collar diameter) for planting versus spring sowings (n = 794). We suspected that an earlier sowing might be necessary to offset the shorter growing season in Virginia. Winter sown seeds were planted during December under 1/4 soil in greenhouse beds, seedlings transplanted to 14 oz. pots 1 month after germination, and pots placed in bottom-watered beds in May. Spring sown seeds were dewinged and sown typically two per pot in May. Winter-sown seeds received two Osmocote fertilizer applications while spring sown seedlings were fertilized once. Root collar diameters were measured Jan.- Feb. 1999. Winter sown seed resulted in a significantly greater proportion of seedlings with larger root collar diameter (> 5 mm) than spring sown seed. We think that the small size of spring sown longleaf pine seedling root collar diameter can be overcome by both sowing in early March and more frequent fertilizer applications.

A PLAN FOR A FUNCTIONAL NATIVE VIRGINIA LONGLEAF PINE SEED ORCHARD. Philip Sheridan, Meadowview Biol. Research Station, Woodford, VA and Dept. of Biol. Sciences, ODU. Increasing longleaf pine reforestation and restoration demands combined with erratic seed crops is resulting in a shortage of commercially available longleaf pine seedlings. There is currently no commercial supplier of indigenous Virginia longleaf pine seedlings, despite the higher quality of this material for in-state planting. The Virginia Dept. of Forestry has initiated a native Virginia longleaf pine seed orchard but production from this facility is decades away. A way to meet the demand for native Virginia longleaf pine seedlings is to utilize the remaining stands as seed sources. Two sites contain 99% of Virginia's 4432 remaining longleaf pine, Blackwater Ecologic Preserve and Union Camp property at South Quay. Although the Blackwater Preserve has almost half the longleaf pine trees in the state, the densest stands for seed harvest are planted Louisiana stock. In addition, seed harvest operations could interfere with ongoing research efforts. Recently, Union Camp Corporation has been acquired by International Paper Company which grows longleaf pine seedlings on a commercial basis. The South Quay tract contains a 300 acre parcel with 2033 longleaf pine trees. Conservative estimates of seed production based on tree diameter result in a yield of almost 100,000 seed per year. We suggest that International Paper Corporation be encouraged to participate in longleaf pine restoration in Virginia by managing this parcel for wildlife habitat, longleaf pine seed production, and ecosystem preservation.

TESTING FOR THE PRESENCE OF A SARRACENIA SEED BANK AND RHIZOME DORMANCY THROUGH A REMOVAL EXPERIMENT. Philip Sheridan^{1,2} and William Scholl^{1*}. ¹Meadowview Biol. Research Station and ²Dept. of Biological Sciences, ODU. Seed banks are known to maintain reservoirs of genetic variation for populations through times of environmental stress. Propagules lie dormant in a seed bank and germinate under conditions favorable for that species survival and persistence. Similarly the phenomenon of growing season dormancy has also been documented in orchid species. Various authors have proposed that *Sarracenia* are released from growing season dormancy when competition is removed. In the winter of 1986 we discovered a site in northern Dinwiddie County, Virginia which contained both *Sarracenia flava* L. (n = 50) and *S. purpurea* L. (n = 26) in a fire suppressed pond pine flatwoods. Due to the possibility of encroaching development we removed all visible plants of both species in January 1989. In 1990 the area was clear cut and the site monitored for the next four years. No plants of *S. purpurea* appeared after the removal and timber cut and only one specimen of *S. flava* appeared which was most likely a resprouted, broken rhizome or a missed plant. These results indicate that after decades of fire suppression in Virginia bogs no *Sarracenia* seed bank remains and that *Sarracenia* do not exhibit a growing season dormancy. Careful investigation of heavily shaded bogs will disclose meager growth on pitcher plants. These stressed plants are easily missed by investigators. As a consequence, when a site is released from competition there is suddenly the appearance of more pitcher plants than was initially observed resulting in the erroneous conclusion of a growing season dormancy. Since most Virginia pitcher plant bogs are fire suppressed, with low numbers of pitcher plants in poor condition, the reintroduction of fire must be carefully handled to avoid destroying these rare plants.

SOCIAL INSECT RESPONSE TO PRESCRIBED BURNS IN A LONGLEAF PINE FOREST. Deborah A. Waller, Biology Dept., Old Dominion Univ., Norfolk, Va. 23529. The Blackwater Ecological Preserve is the northernmost stand of longleaf pine forest in the US. This fire-sensitive habitat is managed with prescribed burns. Social insects such as ants and termites are important in nutrient cycles and may affect vegetation growth after burns. Social insects may respond differently to fire depending on whether they forage and/or nest in soil, litter, logs or vegetation. I compared ant and termite species in burned and adjacent unburned habitats by using litter samples, ant baits and termite baits. Numbers of ant and termite species were comparable in burned and unburned sites. Myrmicine, formicine and dolichoderine ant species were represented in bait samples while myrmicines, formicines and ponerines were found in litter.

HABITAT USAGE AND SPATIAL ECOLOGY OF THE SPOTTED TURTLE (*CLEMMYS GUTTATA*) IN FAIRFAX COUNTY, VIRGINIA. Thomas P. Wilson, Dept. of Biol., George Mason Univ., Fairfax, Va. 22030-4444. Thirteen mature *C. guttata* were equipped with radio transmitters and tracked from spring 1995 to spring 1997 to determine habitat utilization. Spotted turtles can be seen active through out the year with early emergence in February. Sedge meadow and lowland open-forest habitats have the highest frequency of spotted turtle observations. These habitats are used for aestivation, foraging, nesting and hibernation. Sedge meadow in juxtaposition to forest appears to be the preferred habitat at this site. The study site Huntley Meadows Park is an "island" surrounded by residential and commercial urbanization. Also, a healthy population of beaver has dammed several areas causing deep water ponding. Changes in hydrology and habitat have been suggested to alter habitat use patterns of *C. guttata*. Change detection analysis was employed to assess the relative amount of habitat change over a thirty year period. Future plans include continued monitoring of habitat and turtle habitat use. Conservation and management strategies are strongly encouraged to further reduce impacts at this site.

HABITAT PREFERENCE OF THE SPOTTED TURTLE (*CLEMMYS GUTTATA*) IN NORTHEASTERN ILLINOIS, USING THE WALLER-DUNCAN MULTIPLE COMPARISONS PROCEDURE. Thomas P. Wilson, Dept. of Biol., George Mason Univ., Fairfax, Va. 22030-4444. A long term ecological study of the spotted turtle, *C. guttata*, began in 1992 and extended into 1994, additional data were collected in 1997 to 1998. Radio-telemetry and hand capture techniques were employed to collect data on habitat usage and site fidelity. Eight adults were radio tracked in 1992-1994. Spotted turtles often shifted habitats daily, as well as, seasonally. Johnson's habitat preference index indicated that the most preferred habitats were wet dolomite prairie and graminoid fen for the home range area(s) and study site, respectively. Least preferred habitats were dry mesic dolomite prairie and successional-cultural for the home range area(s) and study site, respectively. The Waller-Duncan multiple comparisons procedure was used to test for significant differences in habitat preference ($\alpha=0.05$). A significant difference was determined between the cattail marsh and wet mesic dolomite prairie for home range data. Successional-cultural habitat was shown to be significantly different from the following habitats: mesic dolomite prairie, wet mesic dolomite prairie, cattail marsh, sedge meadow, and graminoid fen. It appears that open low stature habitats (i.e., wet & mesic dolomite prairie) in juxtaposition with closed high stature habitats (i.e., cattail marsh, sedge meadow, & graminoid fen) are the preferred habitat for this turtle in Illinois.

FRESHWATER BRYOZOANS OF VIRGINIA. Judith E. Winston, Virginia Museum of Natural History, Martinsville, VA 24221. Freshwater bryozoans are colonial invertebrates found attached to submerged objects in streams and lakes. Before municipal water supplies were routinely chlorinated and filtered, they were major pests in water supply systems, and even today they can block power plant intake canals or golf course irrigation systems. But bryozoan colonies can be important in natural freshwater ecosystems for two reasons. By feeding on suspended particles of algae and detritus they act as part of the living filter that keeps those waters clean. In addition, colonies of larger species provide shelter for a whole community of invertebrates. In spite of their importance and ubiquity the freshwater bryozoans of Virginia have never been studied. AT VMNH we are carrying out a preliminary survey, sampling first along a transect of the physiographic regions on the state's southern border, paralleling Route 58. Approximately 20 species of freshwater bryozoans are known from the US. So far we have sampled in 10 Virginia counties and have found living colonies of 8 species: *Paludicella articulata*, *Fredericella indica*, *Plumatella repens*, *Plumatella emarginata*, *Pectinatella magnifica* and *Hyalinella punctata*, as well as statoblasts indicating the presence of another species: *Stephanella hina*, previously known only from Massachusetts and eastern Asia. *Fredericella indica* is the most common species in Piedmont streams. *Plumatella repens* is found in streams with nutrient enrichment (e.g., agricultural or sewage pollution). *Pectinatella magnifica* is found in ponds and reservoirs, forming massive gelatinous colonies on sticks and logs. We will be continuing this survey and invite VAS members to participate by letting us know (jwinston@vmnh.org) of localities where they have noticed bryozoan colonies or statoblasts.

ANALYSIS OF UTILIZED VS UNUTILIZED HABITAT IN A POPULATION OF HENSLOW'S SPARROWS, *AMMODRAMUS HENSLOWII*, IN SOUTHWESTERN VIRGINIA. Eric D. Wolf, Dept. of Fisheries and Wildlife Science, Va. Polytechnic & State Univ., Blacksburg, VA, 24061 and Shay Garriock, Va. Dept. of Game & Inland Fisheries, 2206 S. Main St., Blacksburg, VA 24060. The Henslow's sparrow (*Ammodramus henslowii*) is threatened in Va. and its range and numbers are declining throughout the eastern portion of its breeding range. Habitat sampling was conducted at the site of a breeding population in Pulaski County in southwestern VA to compare structure and composition of the vegetation in areas established as territories with adjacent areas that were not used (n=10; level of statistical significance $P < 0.1$). A rod was held vertically at 1m intervals along randomly established 25m transects and number and height of stem hits recorded. Grass density in the territories was slightly greater than in the controls ($P=0.05$). Forb density in the territories was at least 2x greater in every height category than in the controls ($P=0.0007$). Litter depth in the territories was greater than in the controls ($P=0.05$). Distance from transect center to nearest woody or forb species >1m in height was similar in both groups (forbs $P=0.9$; woody $P=0.8$). There was no clear preference for native vs non-native grasses, but some individual plant species appeared to be preferred or avoided.

COMPARISON OF LARVAL MYOMERE COUNTS AMONG *NOCOMIS* SPECIES IN VIRGINIA. T. D. Zorman, Univ. of Richmond, VA 23173, and E. G. Maurakis, Science Museum of VA, 2500 W. Broad St., Richmond, VA 23220 and Univ. of Richmond, VA 23173. Larval myomere counts of *Nocomis platyrhynchus* were made using a dissecting light microscope equipped with polarizing filters, and then compared to those of the three other species of *Nocomis* (*Nocomis leptocephalus*, *Nocomis micropogon*, and *Nocomis raneyi*) found in Virginia. Average preanal myomere counts for *N. platyrhynchus* (26.9) were significantly different from those of the other three species (*N. raneyi*=28.7; *N. micropogon*=26.0; and *N. leptocephalus*=25.9). This is especially important as larvae of *N. leptocephalus*, the only other species of *Nocomis* syntopic with *N. platyrhynchus* in the upper New River drainage, can now be distinguished from those of *N. platyrhynchus*. Larvae of *N. raneyi* also can be distinguished from those of other species of *Nocomis* in Virginia based on preanal myomere counts. However, larvae of *N. platyrhynchus* and *N. raneyi* cannot be distinguished from each other based on total myomeres (42.0 versus 41.7). This study was funded in part by Univ. of Richmond, Science Museum of VA, and VA Academy of Science.

Psychology

THE ORIGINS OF EXPLANATORY STYLE AND ITS RELATIONSHIP TO DYSPHORIA. Rebecca D. Abramson, Robin Lewis, Ph.D., and Jan Halecki, Dept. of Psych., Old Dominion University, Norfolk, Va. 23529. The hopelessness theory of depression predicts that a depressogenic attributional style (DAS) and negative life events may work together to lead to depression. The traits of DAS are self-blame for a negative event, believing the negative cause of the event will be enduring and that it will affect other outcomes in one's life. The present study investigated the relationships between parenting styles, levels of depression, DAS, and the ethnicity of college students. Participants completed two parental behavior inventories, the Beck Depression Inventory, and the Cognitive Style Questionnaire. As expected, level of depression was related to DAS. The higher that participants rated their parents on scales of overprotection and control, the higher they rated themselves on depression and DAS. As parental ratings of care and acceptance increased, depression scores and attributional style decreased. Results suggest that the amount of control a parent has over their child does not affect the child's vulnerability to depression as much as whether the child is controlled at all.

LEARNING FROM SEQUENTIAL TEXTS: EFFECTS OF TEXT COHERENCE, PRIOR KNOWLEDGE AND READING SKILL. Otey Anne Arnold & Danielle S. McNamara*, Dept. of Psychology, Old Dominion Univ., Norfolk, Va. 23529. Investigated the effects of rereading a text versus reading two texts with alternating levels of coherence. The assumption was made that a text low in coherence forces the reader to engage in more active processing, thereby facilitating learning in a reader with prior domain knowledge. Eighty college undergraduates were tested via computer in a 2 x 2 design, with two versions of the same text: both low and high coherence. The results indicated that there was an advantage for reading two different versions of the text, in comparison to rereading the same text. Low knowledge readers benefited from a high coherence text, while high knowledge readers benefited from a low coherence text. There was also an interaction between prior knowledge and reading skill, with less skilled readers who possessed high background knowledge performing better than skilled readers who were low in background knowledge.

THE ROLE OF COACHES IN THE ACADEMIC SUCCESS OF STUDENT ATHLETES. Ellen M. Carpenter, and Terry Dickinson, Dept. Of Psych., Old Dominion University, Norfolk, Va. 23529. Student athletes competing at NCAA Division I institutions are under a great deal of pressure to perform well both in the classroom and the playing field. It is widely believed that the coach plays an instrumental role in fostering an athlete's academic success. However, this belief is based mainly on the anecdotal accounts of athletes. A need exists for empirical research to measure this phenomena. The purpose of this study was to create a behavior observation scale (BOS) capable of assessing NCAA Division I coaches in their role of supporting and encouraging the academic success of student athletes. Thirty-five varsity athletes at Old Dominion University participated in critical incident workshops designed to gather descriptive statements of observed behaviors that were either extremely effective or extremely ineffective in influencing academic success. The statements were then grouped into dimensions by the investigators and retranslated by seven judges. A criteria of 70% was utilized for statements to survive retranslation and also for a dimension to remain. A repeated measure ANOVA showed a significant interaction between judges and dimensions, which indicates a weakness in content validity for some of the items. A total of 49 items comprised the final BOS.

EXPLORING TRAFFIC SAFETY ATTITUDES OF UNIVERSITY STUDENTS: IMPLICATIONS FOR UNDERSTANDING AGGRESSIVE DRIVING AND ROAD RAGE. Jonathan G. Cawthon, Seth D. Tyree, S. Singleton, Dept. of Psych., Christopher Newport Univ., Newport News, VA. 23606, Bryan E. Porter, Dept. of Psych., Old Dominion Univ., Norfolk, VA. 23529, & Thomas D. Berry, Dept. of Psych., Christopher Newport Univ., Newport News, VA. 23606. A driving survey assessed driver beliefs concerning safety, driver abilities, habits and perceptions. A 16 item survey was used to assess the beliefs of 181 participants. Primary results indicated that one's self-rating of driving ability was related to type of road conditions preferred. Male and female respondents showed no self-reported driving ability differences. However, persons who enjoyed demanding driving situations rated themselves as better drivers than persons who disliked such situations. Safety attitudes were found to be negatively correlated with preferred speed on highways. Implications of the findings suggested that pro-safety interventions should target individuals with aggressive speeding preferences.

"LOOKING FOR MR. /MS. RIGHT": DETERMINENTS OF APPEARANCE REFERENCES IN CONSTRUCTION OF SINGLES ADS. Joy M. Cicman, Dept. of Psychology, Old Dominion Univ., Norfolk, Va. Thomas F. Cash*, Dept. of Psychology, Old Dominion Univ., Norfolk, Va. Hypotheses about whether certain personality traits related to what people included in their ad about their own appearance and about the appearance of the person they sought were examined. The traits examined were body image evaluation, psychological investment in appearance, and traditional beliefs about how males and females should interact. In the self-descriptions, there were two significant gender differences: 43% of women included general appearance descriptors and 64% of men did, 81% of women included specific attractive attributes whereas only 68% of men did. Correlational findings indicate that men with the following characteristics made more self-references to their appearance: a positive body image, high investment in their appearance, and a desire to achieve society's ideal appearance. For women, more appearance self-references were related to higher investment in their appearance and holding stronger traditional beliefs about how males and females should interact. Men who were appearance invested and had a more positive body image expressed more appearance preferences for their potential partner. In contrast, women's appearance preferences did not relate to any of the personality measures. Collectively, these findings point to some new and interesting gender similarities and differences in the content of singles ads. For the first time, psychological predictors of the content of the ads have been identified.

THE EFFECTS OF OVARIETOMY AND ESTROGEN REPLACEMENT ON SPATIAL VS. NON-SPATIAL PERFORMANCE. Dawn M. Coulthurst, Jennifer A. Titus and Donna L. Korol, Dept. of Psychology, Washington and Lee Univ., Lexington, VA 24450. Studies conducted on animal models provide evidence that estrogen may have some effect on cognitive function and its ability to improve memory. Previous work in our lab suggests that estrogen might also influence the strategy a rat uses to solve a task. The purpose of this study was to determine the extent to which place vs. cue learning strategies are used in animals with different hormone levels. Using female Sprague-Dawley rats, behavioral training in a plus-shaped maze (✚) provided evidence that estrogen may affect the type and rate of learning upon training. Randomly selected, ovariectomized rats were injected with either estrogen (E) or oil (O); a third group of natural cycling (N) rats was included as well. Keeping the position of the baited arm constant, rats were trained to choose correctly the baited arm. A tactile cue remained in the baited arm throughout testing. Criterion was 9 out of 10 correct choices. A probe test was conducted immediately afterwards, in which the tactile cue was placed randomly in an arm different from the bait, such that the bait and tactile cue were no longer associated with each other. Based on probe trials, the rats were labeled as either place or cue learners. While oil-injected rats seemed to learn the fastest, estrogen influenced the use of the place strategy, with 0% of O, 20% of N and 50% of E using Place strategies. The use of Cue strategies was relatively consistent for all three groups. These results suggest perhaps that estrogen affects learning by influencing the neural systems that subserve different types of learning strategies employed while solving a task.

GENDER DIFFERENCES AND SIMILARITIES IN PARENT-CHILD PLAY. Janine L. DeBellis, Jeffrey Pickens, & Anne L. Stewart, School of Psychology, James Madison Univ., Harrisonburg, VA 22807-7401. This study explored the effects of parent gender, as well as interaction with effects of child gender, on the quality of interaction during parent-child play observed during the Marschak Interaction Method (MIM). The MIM was thus utilized as a context to examine gender differences during play in a series of parent-child dyads. Fathers and mothers interacted with both male and female 3-8 year old children. Videotapes were analyzed using a coding scheme previously developed for use with the MIM. Differences and similarities in the pattern of interaction behaviors for male versus female parents and children were examined. Though differences in style of play were observed, there were no significant gender differences in quality of play interaction. In replication of previous research by McKay, Pickens, and Stewart (1996), this investigation revealed that high vs. low stress parents showed significant differences on MIM Behavior ratings. Individual MIM task analyses are recommended for future research.

AN EVALUATION OF THE EFFICACY OF EEG TO CONTROL ALERTNESS DURING PERFORMANCE OF AN ADAPTIVE VIGILANCE TASK. Holly L. DeVries, & Fred Freeman, Ph.D., Dept. of Psych., Old Dominion University, Norfolk, Va. 23529. Adaptive automation, a system that can adjust its level of operation dynamically, is a growing field of research. Many studies have been conducted resulting in prototype systems capable of integrating various levels of automation with levels of operator performance using psychophysiological adaptive tools such as EEG. The present study examined the ability of EEG to control alertness during performance of a vigilance task within the Pope, Bogart, & Bartolome (1995) adaptively automated closed-loop system. It was hypothesized that under positive feedback, high arousal would result in a high EEG index and low arousal would result in a low index. This was supported by a main effect for period which was found for the EEG index and the performance measures of proportion of hits to target stimulus, A', and reaction time to target. These results supported the use of an EEG index to monitor the activity of the system. Additionally the performance measure, reaction time to target showed significant effects for condition and a significant interaction for condition by period. An EEG index interaction for condition by period approached significance.

BIRTH ORDER INFLUENCES ON SEX ATTITUDES AND INTENTIONS TO USE CONDOMS FOR UNIVERSITY STUDENTS. Stacey L. Edwards, Angie M. Krom, Lanya Savage, C. Sorina Iliescu, Thomas D. Berry, and Kelly B. Cartwright. Dept. of Psych., Christopher Newport Univ., Newport News, VA 23606. University students were surveyed regarding their sex attitudes and birth order. The respondents showed varying levels of intentions to use condoms, given different romantic situations and gender. Male respondents reported having sex with someone they just met more often than female respondents (42% vs 12% respectively). Given respondents were in a romantic moment, female respondents were more likely to practice safe sex than males (71% vs 41%). Also, female respondents were less likely to worry about STDs and HIV than male respondents. A chi square analysis of relative frequency between birth order and number of respondents admitting to having sex with a person they just met was not statistically significant. Implications of this research suggest that further research is needed to determine the association between birth order and safe sex.

EFFECTS OF FRAME OF REFERENCE ON THE NEO-PERSONALITY-INVENTORY-REVISED. Nancy P. Emery & Robert M. McIntyre*, Dept. of Psych., Old Dominion Univ., Norfolk, VA, 23509. The NEO-PI-R was administered to 100 undergraduate psychology students, 49 of them under the instruction that they answer the questions as if the test were part of a job application and 51 under a more natural condition. Participants were randomly assigned to the two groups, which served to highlight any systematic differences that might occur between the two sets of scores. We expected that differences would be revealed in one or more of the factors (Neuroticism, Extraversion, Openness to experience, Agreeableness and Conscientiousness), although Agreeableness and Conscientiousness were especially relevant following research conducted by Barrick & Mount (1991) and Tett, Jackson, & Rothstein (1991). Differences might also have occurred in one or more of the subfactors such as the Dutifulness facet within the Conscientiousness factor or Compliance within Agreeableness. Results showed that frame of reference presumably brought on by the instruction set had no effect on NEO scores.

AN EXAMINATION OF COLLEGE STUDENT DILIGENCE IN COMPLETING QUESTIONNAIRES. Samantha Fogt, Dept. of Psychology, Old Dominion University, Norfolk VA 23529, & Louis Janda, Dept. of Psychology, Old Dominion University, Norfolk VA 23529. After a brief review of the literature concerning college students as volunteers for experiments, the area of diligence was identified as lacking in research. 153 undergraduates volunteered to complete a questionnaire in one of four conditions; early or late in the semester and supervised or unsupervised. The number of invalid responses made on seven target items assessed the total diligence score. The only significant difference found by means of an ANOVA was in the gender variable with men producing significantly more invalid responses. General considerations are proposed when utilizing college students as participants in research.

SELF-BLAME AND SELF-ESTEEM IN CHILDREN OF DIVORCED FAMILIES. Clair Goodman and Jeff Pickens, School of Psychology, James Madison University, Harrisonburg, Virginia 22807-7401. The relationship between self-blame and self-esteem was examined. Neemann and Harter's Self-Perception Profile for College Students was used as both a current and retrospective self-report measure to assess the self-esteem of the college-aged participants. The self-blame scale of Kurdek and Berg's Children's Beliefs About Parental Divorce Scale was used as a retrospective measure to assess participants' self-blaming tendencies. Individuals from divorced families reported significantly lower retrospective self-perceptions than did participants from non-divorced families. There was no significant difference between current self-perception scores in divorced and non-divorced groups. Thus, the self-esteem of divorced participants seemed to recover with the passage of time. Individuals from divorced families reported more feelings of self-blame than did those from non-divorced families. Self-blame scores were not correlated with either self-perception measure. Levels of interparental conflict were significantly related to the self-perceptions of college students from divorced families.

THE HELP-SEEKING BEHAVIOR OF MINORITY COLLEGE STUDENTS. Shanda Jenkins & Barbara Winstead, Dept. of Psychology, Old Dominion Univ., Norfolk, VA 23529. The differences in the help-seeking behavior of minority and non-minority students were investigated. Seventy-five participants were non-minority women, 21 were non-minority men, 43 were minority women, and 16 were minority men. Each participant filled out a 45-question questionnaire about his or her help-seeking behavior. The findings indicated that overall, there were significant differences in help seeking behavior based on minority status, but there were no sex differences. Results also showed that there was a significant difference in only one of four helping services. Women and minorities sought career help significantly more often. Findings revealed that minorities feel that they need help more often in all of the services excluding health services. In addition, significant correlations were found between the perceived need for help and actual help seeking. The race of the helper does not significantly correlate with the probability of seeking help but the sex of the helper does. An overwhelming majority of respondents expressed no preference for the race or sex of a potential helper.

AN ECOLOGICAL ANALYSIS OF RESTROOM DESIGNS AS INFLUENCING HAND WASHING BEHAVIOR AND THE SPREAD OF DISEASE. Angie M. Krom, Stacey L. Edwards, Lanya Savage, Seth D. Tyree, Timothy R. Marshall, and Thomas D. Berrv. Dept. of Psych., Christopher Newport Univ., Newport News, VA 23606. This research explores the design of public restrooms as a risk indicator to the spread of infectious diseases. Here the vector is the design-behavior interaction, where a person enters a restroom, toilets, either washes his/her hands or does not, and exits the restroom. This interaction as a vector has become increasingly important since the identification and spread of antibiotic resistant bacteria. Public health and scientific agencies, such as the Center for Disease Control and American Society for Microbiology, have increased efforts to make the public-at-large aware of the importance and risks associated with washing or not washing one's hands. Researchers surveyed 40 restrooms located within restaurants and fast-food franchises located in the Hampton Roads area. Results indicate that restrooms require patrons to touch restroom equipment controls that could lead to pathogen exposure or re-exposure. Specifically, our analysis suggests that the exterior restroom door may be the greatest vector. Because of the increase in drug-resistant pathogens, this research is important to the future design of public restrooms.

PARENTING STRESS AND SOCIOECONOMIC STATUS AS PREDICTORS OF PARENT-CHILD INTERACTION QUALITY. Michelle LeBlanc, Jeffrey Pickens and Anne L. Stewart, School of Psychology, James Madison University, Harrisonburg, VA 22807-7401. The quality of parent-child interactions is recognized as a crucial issue in determining family functioning and a child's well being. Few studies have measured the effects of parenting stress on parent-child play. We used the Parenting Stress Index to measure stress in the family system for N= 121 families. The Marschak Intraaction Method (MIM), a structured play procedure, was used to measure the quality of parent-child play. As predicted, several subscales of the PSI were negatively correlated with MIM play behavior ratings. This revealed that parents reporting higher levels of stress displayed less optimal interactions with their children, and vice versa. Lower SES families reported more stress and displayed less optimal play interactions. These data have important implications for clinicians and researchers working with families.

THE EFFECTS OF CULTURAL VALUES ON HUMAN RESOURCE MANAGEMENT PRACTICES. Ying Liu & Donald D. Davis*, Dept. of Psychology, Old Dominion Univ., Norfolk, Va. 23529. Knowledge of cultural values can be useful in fashioning management practices intended for multicultural work forces. Six cultural values on the acceptance of culturally different human resource management decisions were examined on both American and Chinese students. Data was collected from 89 Chinese students in US universities using a series of surveys in a take-home packet. A constructed questionnaire of human resource management practices containing vignettes was used to measure the impact of participant cultural values on human resources management practices. Significant differences were found both on culture values of power distance, ascription vs. achievement, universalism vs. particularism, and the relationship to nature and on ratings of human resource management practices between the two different population. Results suggest that culture values may shape management decisions.

ESTROUS CYCLE AND SELECTION OF LEARNING STRATEGY IN FEMALE RATS: DUELING NEURAL SYSTEMS. Emily L. Malin, Kristine A. Borden and Donna L. Korol, Dept. of Psychology, Washington and Lee Univ., Lexington, VA 24450. Considerable evidence suggests that estrogen has potent effects on brain structure and function. Estrogen's actions on learning and memory are less consistent, relating to many factors including differences in task demands or in the strategies chosen to solve the task. Previous work in our lab suggested that female rats are more efficient at place learning when circulating estrogen levels are high. This study was done to test further whether estrogen status at different phases of the estrous cycle affects learning strategy selected by female rats. Naturally cycling female rats were trained in one day to find food on a T-maze in which the position of the start arm and goal arm remained constant throughout training. Rats can use either a place strategy, i.e. go towards the cues in the NE corner of the room or a response strategy, i.e. turn right, to solve the task. Immediately after rats reached criterion, a probe trial was administered in which the start arm was 180° from the start arm during training. Entering the goal arm indicated that a place strategy was used, while entering the arm opposite to the goal arm indicated that a response strategy was used. We found that while the *rate* of learning was stable, the *strategy* selected shifted across the estrous cycle. For example, rats at proestrus or high estrogen, tended to use a place strategy while rats at estrus or low estrogen tended to use a response strategy to solve the task. These data suggest that estrogen affects the strategy selected by activating different neural systems at the time of learning, and have implications regarding estrogen therapy to post-menopausal women and to victims of Alzheimer's Disease.

THE EFFECT OF BEHAVIORAL COUPLES THERAPY ON SPOUSAL VIOLENCE AMONG SUBSTANCE-ABUSING COUPLES. Shannon P. O'Neill, Jamie J. Winters, and William Fals-Stewart, Dept. of Psychology, Old Dominion University, Norfolk, Va. 23529. Behavioral couples therapy (BCT) is effective in reducing the abuse of alcohol and other substances and in reducing levels of domestic violence among alcohol-abusing couples. The prevalence of spousal violence among substance-abusing couples who were randomly assigned to either BCT or individual-based treatment was compared at pretreatment and posttreatment. The two groups had comparable incidences of spousal violence before treatment. After receiving treatment, couples in the BCT condition exhibited a significant decrease in the prevalence of spousal violence. (Supported in part by a grant from the Alpha Foundation.)

A REPLICATION OF ASCH AND LARSEN WITH HIGH FIDELITY CONTROLS: NO DIFFERENCES IN MALE AND FEMALE CONFORMITY. J. Adam Schwabenbauer, April L. Schwabenbauer, Christine A. Larkin, and James P. O'Brien, Div. of Social Sciences, Tidewater Comnty. Coll., Virginia Beach, Va, 23456. Asch (1951, 1956) demonstrated estimates of length of line comparisons were distorted for three-fourths of his male critical subjects by erring majority confederates at least once on 12 critical trials of 18. His two groups of control Ss (N = 37) independently wrote their estimates and erred only 3 times on critical trials (1951). Larsen (1974, 1990) found lower male conformity (36.4%, 50%, respectively) and much higher female conformity (84.6%, 92%, respectively) on this measure. In this study, treatment of 10 male and 10 female controls was virtually identical to the 15 male and 15 female critical Ss except for the presence of the erring confederates (N = 3). Critical Ss' mean error rates and error ranges were similar to those of Asch and Larsen. Like Asch's males, mean error percent for female critical subjects was 32.2%, but only 24.4% for males. Further, 40% of males and 27% of females were completely independent. However, chi squares for experimentals and controls and males and females were not significant ($p = .05$). Additional analyses not used by Asch and Larsen are in progress. It is clear that control groups should be included in any replication of older studies.

THE USE OF STRATEGIES AND THEIR EFFECT ON WORKING MEMORY TASK PERFORMANCE. Jennifer L. Scott, Danielle S. McNamara*, Dept. of Psych., Old Dominion Univ., Norfolk, Va. 23529. This study was conducted to further examine whether strategy use affects the storage component of a working memory (WM) task. In this study, 30 participants were given training to create stories from lists of to-be-remembered words (i.e., chaining) within a short-term memory (STM) task (i.e., including only a storage task). In addition, another 30 participants were assigned to a control condition. Participants in the control condition were given no strategy instruction. Participants in the control and training groups were matched on their level of strategy use (more-strategic, less-strategic) during the STM pretest and were rated on their level of strategy use during the WM pretest and post-test. Both control and training participants improved from pretest to post-test on the STM test; however, only participants in the training condition improved from pretest to post-test on the WM task. Participants who were classified as more-strategic outperformed participants who were classified as less-strategic on all measures including reading comprehension. These results indicate that WM task performance is greatly affected by strategy use.

A CONTEXT ANALYSIS OF ANSWERING SAFE SEX QUESTIONS: COMPARING MAILED-IN SURVEYS TO SURVEYS ANSWERED AT BARS AND CLUBS. Samantha L. Singleton, Seth D. Tyree, Angie M. Krom, Stacey Edwards, Lanya Savage, Kelly B. Cartwright, & Thomas D. Berry, Dept. of Psych., Christopher Newport Univ., Newport News, VA. 23606. This study explored whether different survey collection methods regarding safe sex habits and attitudes would show context differences. One hundred thirty-four subjects participated in completing a Short Sex Survey, which asked questions pertaining to sexual behaviors. The surveys were returned by either (a) hand delivery, or by (b) posted mail. Hand-delivered surveys were filled out while participants were patrons of a singles nightclub. Mailed surveys were assumed to be filled out at the participant's home. The results show that collection method differences exist between older and younger women and not for men of any age. Implications of these findings suggest that women are more context sensitive than men when filling out sex habit and attitude surveys.

PATTERNS OF MOTHER-INFANT TOUCH DURING PLAY AND STILL-FACE CONDITIONS Beth Sydnor and Jeff Pickens, School of Psychology, James Madison University, Harrisonburg, VA 22807. Although touch is an important part of development, few studies have systematically looked at how human mothers touch infants. This study examined natural patterns of touch between mothers and infants in three experimental conditions (baseline play, still-face, and sing vs. play). Three trained observers coded the frequencies of 13 types of touch during 10-sec. intervals for each interaction session. The results indicate that mothers use a variety of types of touching. During the baseline play condition, common types included hand grasping, tickling, "playful" touch, feet grasping, posture adjustment, resting hand, stroking, and caregiving touch. Less frequent types of touch included poking, pinching, orienting, patting, and kissing. During the still-face condition, low levels of touching were observed. Mothers asked to sing vs. play touched their babies less in all touch categories. The findings suggest that instructing mothers to sing facilitates positive interactions and thus it may be a useful intervention for depressed mothers. Mothers may touch babies less during singing vs. play, because maternal singing is so effective and engaging.

EQUIVALLANCE OF TELEPHONIC- AND PAPER-AND-PENCIL BASED SURVEYS. J. Eric Tedford & Louis H. Janda, Department of Psychology, Old Dominion University, Norfolk, VA 23529. One-hundred and twenty-four college students (38 males and 86 females) participated in this study. The overall goal of this study was to ascertain whether or not an automated touch-tone telephone survey is an effective means for collecting data. More specifically, the study looked at: (a) whether or not college aged students who participate in a paper-and-pencil based survey (PP) will make different responses to the same survey administered a week later, in an automated Touch-Tone Telephone format (TT), (b) the same survey was preformed with the TT administered first, followed by the PP version, (c) and measures of coefficient alpha and an ANOVA were preformed for the statistical analysis. The data that was collected from the study seems to suggest that there is a significant difference between the PP and TT versions of the questionnaire. The largest difference between the PP and the TT version of the questionnaire, was only 2.8 on an 80-point scale, however, there was a significant difference between the two groups. It is recommended that that more research be continued in this area. If the results of future studies show that these two methods (TT and PP) are similar, it might be possible to include a wider range of research participants in future studies, in all fields of science.

THE EFFECT OF DIFFERENT FRAMES OF REFERENCE ON PERSONALITY INVENTORY SCORES. Lara B. Tedrow, Department of Psychology, Old Dominion University, Norfolk, VA. 23529, & R. M. McIntyre, Department of Psychology, Old Dominion University, Norfolk, VA. 23529. The purpose of this study was to extend the body of knowledge pertaining to approaches applicants use to complete personality inventories in the application process. One hundred college students were assigned to one of two job conditions and asked to complete the NEO-Personality Inventory-Revised (NEO-PI-R) as if applying for the described job (teacher or employee relations representative). It was hypothesized that participants would adopt job-specific frames of references in completing the inventory resulting in differences in factor and facet scores between the two conditions. No significant differences were found between the groups. Various explanations for the findings are presented.

READING AND NEED FOR COGNITION IN UNIVERSITY STUDENTS. Seth D. Tyree, Angelia Dickens, & Kelly B. Cartwright, Dept. of Psychology, Christopher Newport Univ., Newport News, VA 23606. Individuals vary in need for cognition, the inclination to engage in effortful cognitive activities. Prior research has found that need for cognition is related to a number of variables, but no research has examined the relation between reading and need for cognition. Thus, the current study examined this relation, predicting that need for cognition would be related to reading skill as well as to the frequency with which individuals read. Reading frequency was measured with an index of print exposure, the Magazine Recognition Test (MRT), developed by Stanovich and colleagues. A significant correlation emerged between need for cognition and reading skill. However, this relation appeared to be mediated by verbal ability. Surprisingly, no relation was found between print exposure and need for cognition. This may be because magazine reading requires less cognitive effort than other types of reading, such as book reading. Additionally, the current sample included only college students whose levels of need for cognition may not accurately reflect the general population. Future research should employ additional measures of print exposure and use a more diverse sample of participants.

EXAMINING RELIABLE CHANGE AMONG SUBSTANCE-ABUSING PATIENTS AFTER COUPLES THERAPY. Jamie J. Winters, Shannon P. O'Neill, & William Fals-Stewart, Dept. of Psychology, Old Dominion Univ., Norfolk, VA 23529. Married or cohabitating male substance-abusing patients (N=145) who were entering a drug treatment program received behavioral couples therapy (BCT) as part of treatment. Measures of drug use and dyadic functioning were collected pretreatment, posttreatment, and at quarterly intervals thereafter for 1 year. Growth curve analysis was utilized to classify participants as improved or unchanged for both drug use level and dyadic functioning level. Pretreatment levels of dyadic functioning and drug use and number of BCT sessions attended were associated with improvement in dyadic functioning. Pretreatment drug use level and number of BCT sessions attended were associated with improvement in drug use.

Statistics

ASYMPTOTIC DISTRIBUTION OF ESTIMATED AFFINITY BETWEEN MULTIPARAMETER EXPONENTIAL FAMILIES Steven T. Garren, Division of Statistics, University of Virginia. Let F_1, \dots, F_J be the distributions of J independent multiparameter exponential families, and $\rho_j(F_1, \dots, F_J)$ denote the affinity between F_1, \dots, F_J . We consider the problem of estimating ρ_j on the basis of independent random samples from these distributions. Subject to some mild regularity conditions, we derive the asymptotic distribution of the maximum likelihood estimator of ρ_j . Applications to hypothesis testing and discriminant analysis are discussed, and an example is provided.

RECOVERED ERRORS AND NORMAL DIAGNOSTICS IN REGRESSION. D. R. Jensen, Dept. of Statistics, VPI and SU, Blacksburg, Va. 24061 & D. E. Ramirez, Dept. of Math., 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 recovered errors having the required properties even in small samples, taking into account that such errors are closer to normality than are disturbances in the observations themselves. Details are supplied. In addition, effects on these revised diagnostics due to various model violations are examined.

ASYMPTOTIC RESULTS FOR MODEL ROBUST REGRESSION. B. A. Starnes and J. B. Birch, Dept. of Statistics, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061. Since the mid 1980's many statisticians have studied methods for combining parametric and nonparametric models to improve the quality of fits in a regression problem. Notably in 1987, Birch and Einsporn proposed the Model Robust Regression model (MRR1) in which the parametric model function, f , and the nonparametric model function, g , were combined in a straightforward fashion via the use of a mixing parameter, λ . This technique was studied extensively at small samples and was shown to be quite effective at modeling various unusual functions. In 1995, Mays and Birch developed the MRR2 model as an alternative to MRR1. This model involved first fitting f to the data, and then adding in g according to the lack of fit demonstrated by the error terms. Once again the mixing parameter λ was utilized, only in this instance it was applied to g alone, thereby fully utilizing f regardless of the true function in question. Using small samples, Mays (1995) illustrated the superiority of the MRR2 model to the MRR1 model et. al. in most situations. We have developed asymptotic results for both models in the full knowledge case assuming optimal bandwidth selection procedures. We have also demonstrated that both models are equal asymptotically and presented, for both models, ideal asymptotic mixing parameter estimates.

Astronomy, Mathematics and Physics

AN APPROXIMATION TO NEWTON'S METHOD USING COMPLEX VARIABLES, Brian Bradie, Dept. of Mathematics, Christopher Newport Univ., Newport News, VA 23606-2998. Using the technique of Squire and Trapp ("Using Complex Variables to Estimate Derivatives of Real Functions," SIAM Review, **40** (1), pp. 110 - 112, March 1998), the derivative term in the iteration function for Newton's Method is replaced by an approximation formula which evaluates the function at a complex argument and is insensitive to roundoff error. To economize the number of complex function evaluations, the function value needed by the iteration function is approximated from the same evaluation used to approximate the derivative. The resulting iteration scheme uses one complex function evaluation per iteration, but does not require the evaluation of the derivative. Experiments indicate the method maintains full quadratic convergence. Open research issues are discussed.

WHAT'S NEW IN PHYSICS DEMONSTRATIONS AND SOME DEMOS WITH MATHEMATICS. D. Rae Carpenter, Jr., Dept. of Physics, VMI, Lexington, VA 24450. A few intriguing demonstrations by colleagues seen at recent meetings. Some demos to excite physics students about mathematics and some to excite math students about applications made real with demos. To be shown: Planck's Constant from Radio Shack, $\ln V$ vs $\ln I$ is linear for light bulbs, coupled oscillations in singing rods, corbeling of meter sticks, reaching the Moon by folding paper, hanging chain oscillations requiring Bessel function solution, two notes for a xylopipe with oblong cross section, baby oil extinguishes laser light, toilet paper mechanics, and summing a series using areas.

TOP EXTERIOR POWERS OVER COMMUTATIVE RINGS. Boyd Coan, Dept. of Math, Hampton University, Hampton, Va. 23668. We recall the class of FGC rings as those rings for which every finitely generated R -module may be written as a direct sum of cyclic R -modules and demonstrate that it is coincident with a new class of rings. When the top exterior power of an R -module M is cyclic, we define the non-negative integer $p = \text{crank}(M)$, and show that under the hypothesis that the annihilator of the top exterior power is contained in the Jacobson radical, it counts the maximum number of times that the top exterior power can appear as a direct summand of M . If P is finitely generated projective of constant rank n , then an isomorphism is set up. Finally, a unimodular condition is shown to be a consequence whenever right multiplication is a split map onto the top exterior power of P .

A SURVEY OF CURRENT TRENDS IN MATERIALS SCIENCE INSTRUCTION WITH APPLICATIONS TO PHYSICS AND CHEMISTRY. Wm. Christopher Hughes, Department of Physics, James Madison University, Harrisonburg, VA 22807. Much as the physics community has done in the last few decades, the materials science academic community has begun to look more seriously at innovations in the way they teach their subject. This is of interest to those of us in the more traditional science disciplines because many of the elements of materials science make excellent gateways to physics and chemistry. The talk will review some of the more significant recent efforts at curricular innovation and instructional tools with a review of those that impact secondary and undergraduate physics. Personal perspectives on the incorporation of materials science into an undergraduate physics program in absence of any engineering programs will be included

PHOTONIC MODES IN SEMICONDUCTOR MICROCAVITIES. Peter A. Knipp, Dept. of Physics, Comp. Sci. & Engr., Christopher Newport Univ., Newport News, VA 23606; T. L. Reinecke*, Naval Research Lab., Washington, DC 20375; M. Bayer* and A. Forchel*, Univ. of Würzburg, Germany. We have studied the photonic modes of microstructures formed by lateral etching of a planar cavity having Bragg mirrors. The basic building-blocks of these structures are single microcavities whose lateral shape is either square or circular, and the modes for these cavities are found to behave much like confined photons. Additional structures studied include pairs of microcavities ("photonic molecule"), many microcavities ("photonic crystal") together, and differently sized microcavities ("defects") in a photonic crystal. "Molecules" exhibit "bonding" and "antibonding" states, one-dimensional photonic crystals exhibit band gaps, and "defects" give rise to modes within these gaps. Photoluminescence (PL) experiments provide information about the frequencies of the photonic modes, and angle-dependent PL experiments provide information about the spatial pattern ("wave function") of these modes. Theoretical and experimental results are in good agreement. (Supported in part by the U. S. Office of Naval Research.)

THINGS THAT YOU CAN DO AT CEBAF. Arnie Larson, Dept. of Physics, James Madison Univ., Harrisonburg, Va. 22807. In order for an undergraduate physics student to have a quantitative understanding of results in particle physics experiments it is helpful to have a basic grounding in the concepts of electron scattering. The basic ideas of elastic electron scattering will be presented at an undergraduate's level. The basic ideas of inelastic scattering and how to determine information on the structure of the proton will then be presented. (Supported by the National Science Foundation.)

UNCONSTRAINED REFORMULATION OF CONSTRAINED MINIMIZATION PROBLEMS Wu Li and C. Nahak, Dept. of Mathematics & Statistics, ODU, Norfolk, VA 23529, USA. Consider the following constrained minimization problem:
$$\min_{x \in X} f(x) \quad (1)$$

where X is a closed convex subset of \mathbb{R}^n , $f(x)$ is a twice continuously differentiable function on \mathbb{R}^n . By using Fukushima's regularized gap function $G_a(x)$ for the variational inequality problem derived from (1), Li and Peng suggested to use $P_a(x) = f(x) - G_a(x)$ as a merit function for (1) and proved that (1) is equivalent to unconstrained minimization of $P_a(x)$ when the Hessian of $f(x)$ is bounded and a > 0 is very small. The main purpose of this paper is to give an in-depth study of the relations between $f(x)$ and $P_a(x)$.

APPROACHES IN CONTROLLING INSTRUMENTATION FOR PHYSICS EXPERIMENTS. Joseph S Masters, Dept. of Physics, James Madison Univ., Harrisonburg, Va. 22801. Using the TJNAF, Thomas Jefferson National Accelerator Facility, HALL B EC Laser Calibration System as a model, approaches to controlling instrumentation are discussed. The calibration system calibrates an array of photo multiplier tubes on a large detector/calorimeter. A set of simple commands, written in C, provides the basic control. The commands are loaded on a front end computer which manages the necessary electronics. More complex programs, written in C/C++, issue these simple functions over the network using the TCL Distributed Processing extension as a communication interface. Other design issues such as a visual interface, language choice, and network constraints are described. (Supported by the National Science Foundation.)

SCANNING TUNNELING MICROSCOPY OF ATOMS AND CHARGE DENSITY WAVE STRUCTURES IN PURE AND IRON-DOPED TaS_2 AND $TaSe_2$ MATERIALS
William W. McNairy and Janchaysang Suwatwong, Dept. of Physics and Astronomy, Virginia Military Institute, Lexington, Va. 24450. Images of the surfaces of both pure and iron-doped samples of layered transition metal dichalcogenides have been obtained using a Scanning Tunneling Microscope (STM). Both the 2H and the 1T phases of TaS_2 and $TaSe_2$ were imaged: the 1T phase of each compound possesses an additional contribution from a room temperature Charge Density Wave (CDW). The CDW in 1T- TaS_2 is incommensurate with the underlying atomic lattice; the CDW in 1T- $TaSe_2$ is commensurate. The addition of iron as a dopant can affect the contributions from the CDW. Substitutional doping (in place of the Ta atoms) has little effect: interstitial doping (between the sandwich layers) quickly quenches the CDW. Images reflecting the contributions of electrons from both the atomic and CDW charge distributions will be presented. In addition, images will be presented of the varying CDW pattern in the iron doped materials.

CONSTRUCTION AND CHARACTERIZATION OF A LASER DIODE ASSEMBLY FOR SEMICONDUCTOR SPECTROSCOPY. Timothy J. Nagle and Timothy H. Gfroerer, Dept. of Physics, James Madison Univ., Harrisonburg, Va. 22807. The radiative efficiency of a semiconductor can be evaluated by exciting electrons to the conduction band with a laser diode and taking relative measurements of the energy released in the forms of heat and light when the electrons return to the valence band. Combining these relative measurements, an accurate estimate of the total light emitted by the semiconductor is obtained. The number of photons emitted divided by the number of laser photons absorbed gives the radiative efficiency of the semiconductor. From this relationship it is clear that precise knowledge of the power and energy of the incident laser light is crucial. We have built a laser diode mount, and using a temperature control unit and constant current source, we control and stabilize the optical power of the laser, allowing for a reliable calculation of the radiative efficiency. We find that the power stability is highly correlated with the temperature stability of the laser, and will present results which confirm this. In addition, we find that the thermal stability of the laser mount depends strongly on the responsiveness of the temperature control unit. We have also measured the spectrum of the laser light under anticipated operating conditions to obtain precise knowledge of the excitation energy. Our results indicate that the laser diode assembly has very good optical power stability and a suitable emission energy for our purposes.

AN ELECTRONIC INTEGRATOR CIRCUIT FOR PHYSICS EXPERIMENTS. Philip B. Peters, Dept. of Physics & Astronomy, Va Mil. Inst., Lexington, VA 24450. An electronic integrator circuit has been developed to replace the cumbersome ballistic galvanometer in simple experiments in which a transient flow of charge must be measured. This circuit has proven useful in two experiments to demonstrate electromagnetic induction and in the measurement of an unknown capacitance. When properly adjusted, the operation of this circuit is quite stable and, though the visible deflection of the ballistic galvanometer has been lost, the simplicity of the experimental arrangement has made the use of this circuit greatly preferable.

THOUGHTS ON BLACK HOLES, ETHER, AND PARALLEL UNIVERSES. Joseph D. Rudmin, SEI, 220 University Blvd, Harrisonburg, VA 22801. The physics near an ideal black hole is intuitively explored using easily grasped concepts. Light is used to map out the geodesics in space and time in a region of intense and varying gravitational fields, and to illuminate the motion of particles there. It is shown that a gravitational field can be thought of as a region of excessive volume within a surface; and points in space-time there accelerate away from each other. If time permits, the role of gravitational potentials in defining preferred reference frames will be discussed.

CONJECTURE: THE EXTRA DIMENSIONS ARE NOT ROLLED UP. Joseph D. Rudmin, SEI, 220 University Blvd, Harrisonburg, VA 22801. A conjecture is offered about how the known forces might be unified without recourse to rolled up dimensions, pseudo-potentials, or strings. It is based on the work of Theodore Kaluza, who unified electromagnetism and gravity under general relativity in 1921, and explained the meaning of gauge transformations. In this model, it is shown how (space-like + time-like dimensions) \times (real + imaginary parts of the wave function), under the properties of Dirac matrices, give 3 space + 3 time dimensions, with the properties of angular momentum and flavor. Completeness with respect to matrix multiplication yields color. The assumption that the 3 time-like dimensions are the same yields a rest-mass-like term in the Hamiltonian.

AN APPLIED ENERGY AND INSTRUMENTATION LABORATORY IN THE NEW INTEGRATED SCIENCE AND TECHNOLOGY PROGRAM AT JAMES MADISON UNIVERSITY. Gerald R. Taylor, Jr., MSC 4101, James Madison University, Harrisonburg, VA 22807. A very brief overview of the integrated science and technology program at James Madison University will be presented. Experience teaching an intermediate instrumentation and measurement laboratory in the Energy Sector of the program will be discussed. Experiments in solar, wind, thermal, and nuclear energy using LabView virtual instruments will be described. Preliminary results of a physics education research project into student learning in two- and three-member teams in these laboratories will be discussed.

A POLARIZATION IN ASSOCIATED $K^- - \Lambda$ ELECTRO-PRODUCTION. L. Teodorescu*, P. Guève², T. Angelescu*, O. K. Baker, R. Ent*, M. Guidal*, J.M. Laget*, J. Mitchell*, G. Niculescu*, M. Vanderhaeghen*, and R. Williams*, ¹NuHEP, Physics Dept., Hampton Univ., Hampton, VA. 23668. The result of a feasibility study to measure the Λ polarization in associated $K^- - \Lambda$ electro-production is presented. This measurement was performed in the experimental Hall C at Jefferson Lab. The scattered electron was detected in the HMS spectrometer and the electro-produced kaon and the proton from the $\Lambda - p\pi^-$ decay were both detected in the SOS spectrometer. This quantity is very sensitive to the elementary $p(e, e'K)\Lambda$ process and gives information on resonance production, Regge exchange, duality, and form factors, among others. The result presented was measured at $Q^2 = 1.50 (GeV/c)^2$ and $\cos \theta_{K\gamma}^{CM} = 14^\circ$. The limits of the Λ polarization, with respect to the $\vec{p}_\gamma \times \vec{p}_K$ axis, were found to be -0.21 and +0.89 with a confidence level of 68%. The result is compared to theoretical predictions based on an effective hadronic field Lagrangian model and a Regge framework model.

PRELIMINARY CHARACTERIZATION OF ITO THIN FILMS. Brian M. Woodley, Dept. of Physics, James Madison Univ., Harrisonburg, Va. 22807. A preliminary study of transparent semiconducting thin films is presented. Indium Tin Oxide (ITO) films were deposited on glass slides by RF plasma sputtering and were annealed at 275 °C. Surface properties were explored using Atomic Force Microscopy (AFM) and electrical properties were measured. Grain size, resistivity, mobility, Hall coefficient, and carrier concentration in the ITO films will be discussed. (Sponsored by Dr. Gerald R. Taylor, Jr., faculty advisor)