Abstracts of Papers Presented at the Seventy-eight Annual Meeting, Virginia Academy of Science May 23 - 26, 2000, Radford University, Radford, VA

Aeronautical and Aerospace Sciences

THE RADFORD UNIVERSITY RADIO JOVE PROJECT. K. C. St. Clair, Jason B. Shelton, Leigh A. Kitts, Rian Q. Everett, Joseph M. Waugh & Rhett B. Herman, Radford University. The Physics program at Radford University has recently constructed a radio telescope as part of NASA's Radio Jove Project educational initiative. This telescope, the components of which were provided in kit form by NASA, consists of a double-dipole half wave antenna and a radio receiver tuned to a frequency of 20.1MHz. This frequency is characteristic of radio emissions from processes involving the magnetospheres of Jupiter and its satellite Io, and is fortuitously situated in a relatively radio-quiet region of the spectrum. This frequency is also emitted by certain processes in stellar atmospheres, and thus provides a venue for studying various processes present in our sun. This antenna was built by students in the Electromagnetic Theory class at Radford, presenting them not only with a practical application of the theory from the class, but also giving them experience in building and troubleshooting complex electronics. This project will allow Radford University to join the national network of radio astronomers monitoring Jovian and solar activity.

NUMERICAL INVESTIGATION OF ETHYLENE COMBUSTION IN SUPERSONIC AIR STREAMS WITH PILOT-HYDROGEN INJECTION. Sudenrda N. Tiwari, Ahmed A. Taha & Taj O. Mohieldin, Dept. of Mechanical Eng., Old Dominion Univ., Norfolk, VA 23529. Mixing and combustion characteristics of ethylene fuel in supersonic air streams are investigated numerically. The configuration used features the existence of a generic rearward-facing step in the upper longitudinal wall. The effect of the injected sonic pilot ethylene on the combustion of the gaseous sonic ethylene fuel, that is injected normal to the incoming supersonic air stream, is investigated. The existence of a wedge downstream of the rearward-facing step and upstream of the main normal ethylene injection forms a cavity-like configuration that showed a good potential towards enhancing the fuel-air mixing in addition to helping initiate and stabilize the main flame. The current work is still underway to complete studying the combustion flowfield of the normal injection of the sonic gaseous ethylene with sonic pilot hydrogen. This will lead to a comprehensive study to address the feasibility of using hydrocarbon fuels in the mid-speed range of the hypersonic flight.

NONGRAY RADIATIVE INTERACTIONS OF MOLECULAR GASES IN INCOMPRESSIBLE FLOWS. S. B. Pidugu & S. N. Tiwari, Dept. of Mechanical Engineering, Old Dominion University, Norfolk, VA 23529. Nongray radiative interactions have been investigated under local thermodynamic (LTE) and non local thermodynamic conditions (NLTE). The specific problem considered in this study is a fully developed laminar incompressible flow between two parallel plates. The plates are maintained at uniform surface heat flux and are assumed to be black. The governing equations describing the physical problem along with the boundary conditions are solved numerically by employing the technique known as method of undermined parameters. Results are obtained for two diatomic gases (NO, OH) and one triatomic gas (H_2O). Results are obtained under different pressure (0.1 to 10 atm.) and temperature (300 to 2000 K) conditions. The spacing between plates is varied from 0.01 to 1.0 meters. The results under LTE and NLTE conditions are compared at different temperatures and pressures. The variation of bulk temperature with plating spacing is plotted for different gases under both LTE and NLTE conditions. Results indicate that, in general, the radiative ability of the gases increase with the increase in temperature, pressure and plate spacing. The NLTE effect becomes significant at lower temperatures and pressures. Among the gases, OH shows least radiative effect while H_2O shows the highest radiative interactions under both LTE and NLTE conditions.

SCIENCE FAIR MENTORING PROGRAM: UNIVERSITY VOLUNTEERS HELPING SCIENCE FAIR STUDENTS SUCCEED. Mary E. Manning & Adam Possner, College of Arts and Sciences, University of Virginia, Charlottesville, Va. 22904. In 1998, students at the University of Virginia founded a mentoring program to help elementary, middle and high school students succeed in science fair by uniting them with the guidance of undergraduates, graduates and professors at U.Va. This novel program has engaged over 80 mentors in aiding students from diverse socioeconomic backgrounds in the completion of a science fair project. Working in partnership with local schools, mentors visit with students once a week to encourage innovative ideas, refine concepts, answer questions, and help develop procedures. Personalized attention and encouragement from mentors who have successful academic careers gives younger students confidence in their studies and enthusiasm for scientific research. Over 90 percent of student participants completed a science fair project with their mentor, and several competed in higher level competitions. Run entirely by student volunteers, this program could serve as a useful model for launching a volunteer mentoring organization at a college or university or in the community at large.

NUMERICAL STUDY OF CHARACTRISTICS OF TWO DIMENSIONAL PLANE PARALLEL JETS. S. N. Tiwari, T. O. Mohieldin & T. M. Abdel-Salam, Department of Mechanical Engineering, Old Dominion University, Norfolk, VA 23508. Effect of various parameters on the characteristics of two dimensional turbulent plane parallel jets were numerically studied. Flow geometry under consideration is a two parallel plane jets of 4mm width each. Effects of nozzle spacing (D/a) and nozzle exit velocity (U) on both merging and combined points are investigated using an existing CFD code "FLUENT". Six different values of D/a are used ranging between 8 to18. Also, nine different jet velocities have been examined corresponding to Reynolds number of 8,000 to 36,000. The results provide acceptable agreement in comparison with the experimental results. It is noted that the ratio D/a linearly affect the location of the merging and the combined points, while velocity plays no role in their location.

SIMIULATION OF THE GLOBAL POSITIONING SYSTEM (GPS) TO COMPUTE THE GEOMETRIC DILUTION OF PRRECISION (GDOP). Abdul Ghafoor Al-Shehabi, Aero. Dept., Old Dominion Univ., Norfolk, VA, 23529. GPS is the latest technology in navigation and location determination. The principal behind GPS is the measurement of ranges between the receiver and the satellites. Due to the relative motion of satellites, the distances and geometry of the visible satellites are time dependent. A measure of the geometry is the Geometric Dilution of Precision (DOP) factor. Deriving equations that give the user's position, calculating GDOP factor and investigating how this factor is affected by the geometry of visible satellites are goal of this research. GDOP factor and other factors related to GDOP are introduced by linearizing the pseudorange equation, this linearization represents the changes in user position and time bias. An algorithm by which, the receiver can determine the visible satellites and which is the best set of four satellites of many satellites in view is developed, the best set is that which gives us the optimal GDOP. The optimum configuration is used to perform the position calculation. To achieve this goal, a powerful aerospace analytic software tool called (STK) developed by Analytical Graphic, is used to get the required trajectory data necessary as input to exercise, test and run our navigation algorithms for calculating the GDOP factor.

AERODYNAMIC CHARACTERISTICS OF AN AIRPLANE CONFIGURATION WITH SEVERAL BODY ARRANGEMENTS. M. Leroy 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. A review has been made of some existing wind-tunnel data for the purpose of assessing the aerodynamic behavior of airplane designs having various multiple body arrangements. The use of multiple bodies rather than conventional single bodies provides a means of increasing volume without undesirable increases in body length and diameter. In addition, multiple body arrangements provide for various alternate locations of the wing lifting surface and the stabilizing and control surfaces. The review indicates that muliple body arrangements, in comparison to single centerbody arrangements, might have a positive effect in some area's such as weight reduction, longitudinal, lateral, and directional stability, utilization of interference flow fields, and reduction of wing tip vortex strength.

STUDIES OF THE AERODYNAMICS OF THE INBOARD WING CONCEPT. Matthew Orr, Samantha Magill, James Marchman, William Mason, Joseph Schetz, & Bernard Grossman, Aerospace and Ocean Engineering Dept. Va. Polytechnic Inst.& State Univ., Blacksburg, VA 24061. This investigation examines a new concept in airliner configurations. This concept proposes mounting the fuselages at the tips of a low aspect ratio wing. The motivation for this configuration is to provide an increase in the number of passengers carried with no increase in span or length over conventional designs. An additional motivation is the change in the wake flow of the wing due to the fuselages and vertical tails. This may reduce the effect of the trailing vortex on trailing aircraft. This investigation used two models of different size that provided measurement of the forces, moments, and flow properties in the wake. These data were used to aid in the validation of numerical models of the flow around and behind the configuration. The L/D values found for the non-optimized configuration were modest compared to those for conventional transports. The vertical tails were shown to act as winglets, reducing drag and increasing L/D. One important result in the wake was that the maximum swirl velocities were less than for the plain wing of the same span, chord, and total lift. All of these results suggest areas for substantial improvements in aerodynamic performance.

AEROELASTIC FORMULATIONS OF LIFTING SURFACES IN VARIOUS FLIGHT SPEED REGIMES FOR FLUTTER AND RESPONSE ANALYSES: INDICIAL FUNCTION APPROACH. Piergiovanni Marzocca & Liviu Librescu, E.S.M Dept., Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. This paper deals with the generation and the use of new indicial functions towards the aeroelastic formulation of two-dimensional lifting surfaces, in the subsonic compressible and supersonic flight speed regimes. The indicial function approach enables one to treat in an unified way, i.e. in the time and frequency domains the various problems of the aeroelasticity of lifting surfaces. Such an approach yields the proper aerodynamic loads necessary to the study of the subcritical response of the open/closed loop aeroelastic systems, and of flutter of lifting surfaces, respectively. Counterparts of Theodorsen's and Wagner's functions extended in the subsonic compressible and supersonic flight speed regimes enable one to express correspondingly the aerodynamic lift and moment in the frequency and time domains, respectively. Validation of the model, closed form solutions and aerodynamic derivatives for different flight speed regimes are obtained, graphical representations and results displaying the aeroelastic response to blast loads are presented and pertinent conclusions are outlined. The first author gratefully acknowledges the support by the Centro Studi per la Dinamica dei Fluidi of the Italian National Research Council (CNR).

PROPELLER SLIPSTREAM EFFECTS ON THE AERODYNAMICS OF UAVS AT LOW REYNOLDS NUMBERS. Ehab A. Elsaadawy & Colin P. Britcher, Department of Aerospace Engineering, Old Dominion University, Norfolk, VA, 23529. Aiming to develop aeronautical technologies that will lead to a new family of Unmanned Arial Vehicles (UAVs), a number of groups are developing atmospheric science aircraft to fly at extreme altitudes, up to 100,000 ft. Many of these aircrafts are propelled by turbocharged piston engines driving tractor or pusher propellers. The effect of the propeller slipstream (wake) on the aerodynamic performance of the airframe, wings and air inlets, at low Reynolds numbers is the subject of this study. Propeller slipstream is known to affect the transition location, and the laminar separation bubble extent, consequently, drag forces and heat transfer on the wing. Through this study, a laminar flow and 2-D inlet airfoil are used as models to generate different types of boundary layers. The laminar flow airfoil is used as a benchmark case and the results obtained are compared with computations by the MSES code, a widely used code for 2-D single element and multi-element airfoils. Results show a laminar-turbulent-reverse transitional behavior in the boundary layer that emphasizes the fact that the propeller slipstream does not cause a total loss of the laminar boundary layer as was previously postulated.

Agriculture, Forestry, and Aquaculture

TOCOPHEROL (VITAMIN E), POLYUNSATURATED FATTY ACIDS INTERACTIONS: EFFECTS ON CHOLESTEROL AND TRIGLYCERIDES. A. I. Mohamed[1] and A. S. Hussein[2], [1]Agricultural Research Station, Virginia State University, Petersburg, VA 23806, [2]United Arab Emirate University, El-Ein, United Arab Emirate. The effects of feeding menhaden fish, olive or coconut oil at three different levels of Vit. E (100, 300, and 600 IU) on serum and liver total cholesterol (TC), HDL cholesterol (HDL-C), triglycerides (TG), phospholipids (PL), total lipids (TL) and fatty acid pattern of male Sprague-Dawley rats were studied. Diets were fed for 28 days to 6 individually caged rats in a factorial designed experiment. In serum, means were 38.2, 64.2, 67.0 for TC; 32.5, 53.8, 75.4 for TG; and 25.7, 48. 0, 48.6 mg/dL for HDL-C for rats fed menhaden fish, olive and coconut oil, respectively at three different levels of Vit.E. In the liver, means were 5.7, 7.6, 4.6 for TC; 46, 55, 69 for TG and 5.7, 3.0, 4.7, for PL for the same treatments. Statistical analyses indicated that F value of the means of the measured parameters were significant ($P < 0.0001$) for oil treatment; but were not significant for Vit. E treatments. Interactions between Vit. E and oils were not significant. Pearson's correlation coefficient were 0.655 ($P < 0.0001$) between serum TG and TC,0.568 ($P < 0.0003$) between serum TG and HDL -C, 0.731, ($P < 0.0001$) between serum TC and HDL- C, and 0.923 ($P < 0.0001$) between liver TG and liver TL.

AGRONOMIC AND NUTRITIONAL EVALUATION OF VEGETABLE SOYBEAN. T. Mebrahtu, T. Andebrhan, & A. L. Mohamed, Virginia State University, P. O. Box 9061 Petersburg, Va. In addition to oil and soyfoods, soybean may be produced as a vegetable. The importance of consuming soybean for the prevention of chronic diseases, such as heart diseases and cancer has motivated soybean breeders to investigate the nutritional attributes of vegetable soybean. Thirty-one vegetable soybean genotypes from Maturity Groups (MGs) III to VI were planted at Randolph Farm, Agricultural Research Station of Virginia State University, Petersburg, Virginia. The genotypes were analyzed for lipid, protein, fatty acid profile and isoflavones contents, at immature green pod stage. The significant genotype differences for the seed traits studied suggested that genetic variation exist among the genotypes for selection and improvement. The associations of plant height with fatty acid ratio, total, and protein were significant and negative. On the other hand, the association of number branches/plant, nodes/branch, nodes/stem, and pods/plant with ratio and total fatty acids and protein were significant and positive. These results suggest the architectural traits could be used an indicator to predict genotypes with high protein, fatty acid ratio and total. Selection for genistein, daidzein, and total isoflavone should focus on early MG genotypes. Recognizing soybean isoflavones constitute a powerful tool in quest for healthy life, further research is needed to identify and develop superior genotypes that fit into special niche markets.

SPECIES EFFECTS ON PERIPUBERTAL SPERM RESERVES IN SMALL RUMINANT MALES. B.L. Sayre & S. Wildeus, Virginia State University, Petersburg 23806. Sperm reserves were evaluated in peripubertal, co-raised ram lambs (Katahdin & Barbados Blackbelly; 5/breed) and bucklings (Myotonic, Nubian, Pygmy, and Spanish; 5/breed). Scrotal content was collected at necropsy at 6 mo of age. Testicular and epididymal segments were processed for sperm concentrations. Testicular sperm reserves were greater ($P < .05$) in hair sheep than meat goats (515.3 and 336.1 million sperm, respectively), while epididymal sperm reserves were greater ($P < .05$) in meat goats than hair sheep (108.4 vs. 47.6; 194.7 vs. 121.0 million sperm for caput and cauda sections respectively). Differences in testicular sperm production per gram of tissue were not evident between species. Age was positively correlated (.35; $P < .05$) with epididymal sperm reserves and scrotal circumference was positively correlated to testicular (.66; $P < .001$) sperm reserves. Sperm reserves did not differ among breeds of meat goats or hair sheep. Data indicated differences in sperm reserves between species. However, differences in testicular sperm reserves can be explained by differences in testicular size. All animals were capable of producing sperm and most had adequate reserves available for breeding. Thus, hair sheep and meat goat males are capable of breeding by six months of age.

EXPRESSION OF CONFORMATIONAL DIFFERENCES IN MYOTONIC AND SPANISH GOATS THROUGH LIVE ANIMAL MEASUREMENTS. Michaela P. Dismann and S. Wildeus, Virginia State University, Agricultural Research Station, Petersburg, VA 23806. The Myotonic goat is considered an endangered breed, with significant production potential by the National Animal Germplasm Program. Since there is a need to determine conformational traits in this breed, live linear measurements were taken in young and mature Myotonic and Spanish goats of both sexes (n=5 per group). Measurements were taken with scissor-type calipers and ruler, with animals restrained in a natural standing position and right lateral recumbency. The data were analyzed in a model with breed, age and sex as main effects and body weight as covariate. Mature Myotonic (45.6 kg) were smaller ($P<0.001$) than Spanish (61.2 kg) goats. This difference was reflected in a smaller ($P<.001$) wither height (60.9 vs. 70.8 cm), and reduced ($P<.001$) leg bone (radius, metacarpus, tibia and metatarus) length, as well as a smaller ($P<.05$) hip–wither length (44.0 vs. 52.1 cm). However, hip width was not ($P>.1$) affected by breed. Data indicate distinct skeletal differences between breeds in height and length, but not width; hence the appearance of a greater width in the Myotonic breed may be associated with heavier muscling.

MONITORING INSECT PESTS TO REDUCE PESTICIDE APPLICATION IN SWEET CORN. Mark E. Kraemer and Carl E. Niedziela, Jr. Agricultural Research Station, Virginia State University, Petersburg, VA 23806. Sweet corn production is one of several alternatives to tobacco production in Virginia and is important to new farmers' markets established by the State. Our objective was to evaluate an integrated pest management (IPM) strategy that relies on timing pesticide applications to population levels of the most economically significant pest, the corn earworm, *Helicoverpa zea* (Boddie). Two pheromone traps monitored the moth population from tassel to harvest maturity. Plot size was 6 corn rows of 50 feet in length. Each treatment was replicated 4 times. Warrior® was applied with a drop-down sprayer at intervals of 3 days, 5 days, and according to the IPM threshold values. Moderate to low numbers of moths were present during most of the critical period and the IPM plots were treated with pesticide every four days, except towards the end when very low moth populations allowed a 6 day interval. All spray treatments had at least 95% of corn ears with no corn earworm damage and 90% free of all insect damage. The control treatment had 90% of ears damaged by insects, 76% by corn earworm. The IPM spray schedule reduced pesticide application by at least one spray application without increased insect damage.

PROJECTING GROWTH OF LOBLOLLY PINE UNDER CHANGING ENVIRONMENTAL CONDITIONS. James A. Westfall & Harold E. Burkhart, Dept. of Forestry, Va. Polytechnic Inst. & State Univ., Blacksburg VA 24061. Growth and yield models are capable of projecting tree growth over a range of stand conditions. Process models have the ability to account for how environmental conditions affect tree growth processes. A linked system composed of a growth and yield model (PTAEDA2) and a process model (MAESTRO) was developed. This system incorporates effects of stand structure and changing environmental conditions into loblolly pine growth projections. The basis of this linkage is an equation that modifies site index, a key driver variable in PTAEDA2. The adjustment to site index is based upon changes over a given time period in net photosynthesis (NPS), which is an output of MAESTRO, and in stand density. The equation was evaluated using long-term data from 100 unthinned plots across the Southeast. CO_2 levels were adjusted in MAESTRO to reflect the ambient concentrations present during plot growth. The mean predicted site index change was +0.278 ft./yr. This site index adjustment was incorporated into PTAEDA2 and growth simulations were performed for each of the 100 plots. The use of the site index modifier resulted in a mean predicted plot volume that was not significantly different than the mean observed plot volume ($p = 0.92$).

WINTER EFFECTS UPON HYBRID STRIPED BASS PRODUCTION IN VIRGINIA. Scott H. Newton and Ali Mohamed, Agriculture Research, Virginia State University, Petersburg, VA 23806. Hybrid striped bass produced in ponds are generally harvested for market sales during the fall of their second growing season. As the industry grows, there may be the need for spreading fish harvests and sales into the following spring when prices may be better due to less fish available. Market-size bass were held in a pond at Virginia State University from December to May to observe possible changes during this period in net yield and individual fish condition. A loss in fish yield occurred due to a 10% mortality toll and a net loss in fish weight, even with winter-feeding during this period. Individual fish lost an average of 2% of their mesenteric fat during the 5 month winter period. For economic reasons, the present recommendation is to sell hybrid striped bass when they reach market size to avoid profit losses by attempting to hold them over winter for spring sales.

BLOOD CHEMISTRY OF CAGE-REARED CATFISH AND RAINBOW TROUT IN VIRGINIA. David Crosby, Cooperative Extension, PO Box 9081, Virginia State University, Petersburg, VA 23806. Serum blood chemistry (total protein, glucose, and calcium) was taken from rainbow trout and channel catfish held in cages. The primary objective of the study was to establish the baseline parameters of the blood chemistry for fish in cages. Rainbow trout were sampled monthly from December 1998 to April 1999 and catfish were sampled nine times from June 1998 to August 1999 with each sample consisting of ten fish for each species. The over-all blood chemistry averages for rainbow trout were 3.23 g/dl (sample averages ranged from 2.74 to 3.89 g/dl) for protein, 117.28 mg/dl (sample averages ranged from 78.09 to 124.71 mg/dl) for glucose, and 8.86 mg/dl (sample averages ranged from 3.17 to 12.92 mg/dl) for calcium. The over-all averages for catfish were 3.96 g/dl (sample averages ranged from 3.11 to 5.27 g/dl) for protein, 82.44 mg/dl (sample averages ranged from 38.48 to 124.36 mg/dl) for glucose, and 9.25 mg/dl (sample averages ranged from 10.29 to 13.05 mg/dl) for calcium. Generally, blood chemistry parameters fell within published values for catfish and rainbow trout.

ECONOMIC ANALYSIS OF POND MONOCULTURE OF FRESHWATER SHRIMP IN VIRGINIA. Brian L. Nerrie & Debra Prior, School of Agriculture, Science and Technology, VA State Univ., Petersburg, VA 23806. The tropical freshwater shrimp, *Macrobrachium rosenbergii*, has successfully been cultured at research facilities in the temperate region of the United States. An enterprise budget was estimated based on results from initial private sector shrimp culture efforts and simulated commercial production in research ponds. Stocking density was 12,500 shrimp per acre. Shrimp were fed a 32% protein sinking catfish pellet during the 120-150 day growing season from May to October. Minimum water temperature for growth of tropical shrimp is 20° C. Harvest was by seine and complete drainage of ponds. Shrimp were marketed on ice at pond bank or through local seafood retail outlets. Returns to land and management varied from $400 to $900 per acre based on survival. More than 50% of total cost was due to purchase and delivery of juveniles. Substantial savings could be achieved by establishment of local hatchery.

PRELIMINARY RESULTS FROM SUMMER FLOUNDER (*Paralichthys dentatus)* GROWN ON COMMERCIAL FEEDS IN RECIRCULATING AQUACULTURE SYSTEMS. Ryan W. Cool, M. Schwarz, M. Jahncke, J. Koo & R. Lane, Virginia Seafood Agricultural Research and Extension Center (VSAREC), 102 S. King Street, Hampton, VA 23669. Recirculating aquaculture has become a key focus of seafood research at the VSAREC. We have been working with summer flounder (*Paralichthys dentatus*) since June 1998. Summer flounder are a new species to the aquaculture industry and pioneer research is needed to create a viable aquaculture species. We receive our fish at ~2-4 grams and hold them in a quarantine/isolation facility for at least 90 days. These fish are weaned on commercial feeds, rich in protein and lipids, which are essential for enhanced fish growth. Water quality and fish behavior are monitored daily to maintain an optimal, stress-free environment. Our fish have been very successful thus far with over 50% survival, increased growth over time and a Food Conversion Ratio (FCR) between 0.78 and 1.27. From the isolation system, the fish move to a larger, air-driven recirculating system. This system was designed to reduce operating costs and possible catastrophic pump failures. Our first batch of flounder received in June 1998 are currently averaging over a pound, with some fish over three pounds.

Archaeology

THE JOHN SMITH MAP AND NATIVE AMERICAN REGIONAL SOCIETY. Mike Klein (MWC), Martin Gallivan (W&M), and Josh Duncan (MWC). Situating contact between Europeans and Native Americans within an evolving regional system reorients our view of the Contact Era away from specific historical details toward underlying processes. John Smith's remarkably accurate *Map of Virginia* serves as the primary cartographic documentation of early seventeenth-century regional social relations in the southern Middle Atlantic region. Since Smith's map provides village location during the two-year period when Smith explored Virginia, and documents the majority of villages located along the Coastal Plain rivers, this map overcomes problems of contemporaneity and preservation that often plague settlement pattern analysis. This analysis indicates that 1) the position of the lower Rappahannock within the Chesapeake Bay exchange system explains the concentration of villages along the north shore of the Rappahannock River; and 2) that the collapse of the regional exchange system contributed to the late seventeenth-century abandonment of the Northern Neck by many Native Americans.

THE BONE TOOLS RECOVERED FROM THE LATE WOODLAND PERIOD TRIGG SITE (44MY3), MONTGOMERY COUNTY, VIRGINIA: TYPOLOGY, SYMBOLISM, AND SYMMETRY. Michael B. Barber, George Washington & Jefferson National Forests. During the excavations of the Trigg site in the early 1970s, a large number of modified animal bones were recovered. Although associated with a salvage effort and with a lose of provenience of many artifacts due to a fire, 982 bone tools survived and were included in the current analysis. Ninety-five different tool types were identified with the most frequently recovered categories being turkey wing digit beads, cylindrical bird bone beads, turkey tarsometatarsal awls, antler drifts, blunted bear fibula weaving tools, and box turtle shell cups. Specific cultural issues were discussed concerning the implications of bone tools with regard to the sacred and the mundane, shamanism, clan affiliation, site relationships, the deer skin trade, gender, and symmetry and world view. Future research directions were discussed.

CONCORDANCE OF SKELETAL AND DOCUMENTARY EVIDENCE: SELECTED EXAMPLES FROM HISTORIC VIRGINIA CEMETERY POPULATIONS. Donna C. Boyd, Radford University. Since the 1970s, there has been a significant increase in the number of historic cemeteries unearthed in North America, often with associated documentary evidence. A direct comparison of this documentary evidence with the osteological information derived from an analysis of the skeletal remains from these cemeteries is the primary focus of this paper. Using examples from two historic Virginia cemeteries (the Marshall Tract Burial Ground and the Jones Cemetery), the degree of concordance of these two types of data is investigated. This comparison involves a discussion of the implications for concordance and discordance of skeletal and documentary evidence, a critical evaluation of the validity of both types of evidence, as well as an assessment of the advantages, problems, and limitations when these approaches are combined. It is seen that when multiple lines of evidence are investigated and correlated, we can understand the lives and deaths of past peoples interred in historic cemeteries.

ARCHAEOLOGICAL FIELDWORK AT A CIVIL WAR EARTHWORK AND CAMPGROUND: THE CARRIESBROOK SITE (44FK66). Matt Webster (MWC) and Mike Klein (MWC). During the 1960s and 1970s, historical archaeologists placed themselves at the center of debates about method and theory. As historical archaeology became widely accepted as a legitimate field of inquiry, the need to justify excavation by reference to the service it provided prehistorians evaporated. However, as deforestation, expanding transportation networks, warfare, and political consolidation force Hunter-Gatherers off even marginal lands, and expanding highway systems lead to the loss farmland and forest to suburban sprawl, it appears time to further explore the potential contribution of historical archaeology to the development of archaeological method and theory. The ongoing analysis of the Carriesbrook Site, located near Winchester, Virginia, forms the basis for an exploration of issues common to the archaeology of both Civil War encampments and the sites produced by mobile foragers, specifically: 1) the problems of locating and characterizing low-density, dispersed scatters of artifacts archaeologically; and 2) the potential contribution of Civil War archaeology to an understanding of the relationship between intended and actual length of stay and assemblage and feature diversity and density.

LOCATION, LOCATION: TESTING PREHISTORIC SETTLEMENT MODELS IN SHENANDOAH NATIONAL PARK. Carole L. Nash, James Madison University. A recent cultural resources survey in Shenandoah National Park has led to the reconsideration of previously developed predictive models for prehistoric settlement in the Blue Ridge. Phase I testing of seven areas predicted by the models as "high probability" for significant prehistoric sites found that such sites were located in only four of these. While the four sites offer evidence of repeated occupation as small base camps (through a wide variety of artifacts types and vertical separation of strata), the fifth and sixth locations offered evidence of only ephemeral occupation and the seventh was bereft of cultural materials. By assessing the variables commonly used to predict "high probability" mountainous locations (distance to water, slope, elevation, the sheltered nature of the locale, access to high quality raw material), the current study found that an additional variable may be needed to refine the predictive model: access to a perennial stream hollow. The four site areas share this variable while the three evidencing minimal occupation do not. The study suggests that stream-based travel routes connecting the uplands and lowlands were

MULTIDISCIPLINARY RESEARCH ON 19TH CENTURY MILITARY AND INDUSTRIAL SITES IN SALTVILLE, VIRGINIA: A PRELIMINARY REPORT. Cliff Boyd, Robert Whisonant, Bernd Kuennecke, Loretta LeMay, Brendan Cox & Ryan Murley, Radford University. Geology, Geography, and Anthropology students and faculty from Radford University are currently conducting a multi-year project to investigate nineteenth-century military and industrial sites in Saltville, Virginia. This NASA-funded project has focused on using archival and oral history data as well as remote-sensing data provided by infrared imaging, electromagnetic induction, and other methods to locate sites. Two sites were intensively tested in 1999 and 2000 by the senior author and Radford University archaeology students. The investigation of these two salt furnace sites—used for the production of salt from locally available brine—is described and the various methods of remote sensing used are evaluated.

A JASPER QUARRY AND WORKSHOP (44RB323) IN ROCKBRIDGE COUNTY, VIRGINIA: WHAT WAS GOING ON THERE? Eugene B. Barfield, U.S.D.A. Forest Service, (Ret). This Quarry and workshop site has produced thousands of artifacts with intermittent Native American occupation beginning ca. 10,000 years ago. Most of the artifacts are expedient rather than formal tools and are morphologically indicative of use for certain tasks. Sixty percent of these tools working edges or points are heat treated even though research has shown that this procedure reduces tensile strength of the jasper lithic by 50%. There are advantages to heat treating prepared cores in the normal reduction sequence of micro and cryptocrystalline lithics. The majority of tools found here are, however, expedient and not intentionally reduced to the normally symmetrical and finely finished formal stone tools seen at most other sites. The reasons or cognitive processes of these inhabitants for heat treating their tools are therefore a mystery. Photomicroscopy and scanning electron microscopy are used to view lithic topography in areas of high use-wear and damage in an attempt to determine what materials were worked upon. Results were compared to previous research from cognitive archaeologists. Prehistoric behavior such as butchering, hide-working, and modifying bone and wood to tools or weapons were determined.

Astronomy, Mathematics, and Physics

USE OF WEB-BASED RESOURCES FOR THE PHYSICS CLASSROOM: WEBASSIGN AND WEBDEMO. William W. McNairy, Dept. of Physics, Duke University, Box 90305, Durham, NC 277080305. At North Carolina State University two Web-based programs have recently been developed that can significantly improve physics courses. WebAssign (http://webassign.net/info/: marketed the NCSU Physics Education group) aims to deliver homework problems to students via Web browsers. A wide variety of problem types (either from a large database linked to physics texts or those created by the instructor can be assigned to students.) Analysis of students' performance can then be used to focus classroom discussions (see the Just in Time Teaching method by Gregor Novak et al. In addition, the Keith Warren at NCSU has developed a database of demonstrations accessible from the Web (see http://demoroom.physics.ncsu.edu/). WebDemo uses the PIRA classification scheme to sort classroom demonstrations for use by faculty who are generally unfamiliar with available demonstrations. A team from Duke is assisting in the development of a version of WebDemo that can be readily used at other institutions. Web access to the demonstration collection makes it more readily available (and more used!) by faculty across the curriculum. WebDemo permits the linking of key features of each demonstration: images, movies, links to published articles, source references and other invaluable information. Additionally, WebDemo can be used as a scheduler and can track the frequency of use of each demonstration.

AN INEXPENSIVE LAPTOP-BASED MULTI-LEAD SEISMIC ARRAY. Rhett B. Herman, Radford University. Seismic studies constitute one of the most important areas of study in undergraduate geophysics courses. Yet purchasing such equipment from commercial vendors is typically prohibitively expensive for most undergraduate institutions. In this talk, a method is presented for constructing an eight-lead seismic array whose cost is more than an order of magnitude less than that of the most basic commercial arrays. The geophones were acquired as surplus equipment at zero cost from a commercial geophysical prospecting company. The seismic cables are constructed from Category 5 computer network cable, hardware-store springs and claw clamps, and shrink wrap tubing. The data is collected and analyzed using the program LabView® and a 68-pin connector block, both available from National Instruments. The data collected with this array is comparable to that acquired by commercial arrays.

ANALYZING THE STABILITY OF PHOTOMULTIPLIER TUBES. Jason C. Mace & Kevin L. Giovanetti, Department of Physics, James Madison University, Harrisonburg, VA 22807. All detector systems have active components that change over time. A system has been installed in the forward calorimeters for the CLAS detector at Thomas Jefferson National Accelerator Facility to monitor photomultiplier tube drifts. Data was acquired during a data-recording period for the CLAS detector using a Laser Calibration System the analysis of this data and future plans for the use of the Calibration System will be discussed. This work is supported by the National Science Foundation.

KILLER ASTEROID 3200 BC. Joseph W. Rudmin Physics Dept, James Madison U. Evidence for the destruction of Ur in Sumer, c. 3200 BC is presented. The evidence includes sulfates deposited in the Greenland ice cap, statistical support from impact frequency vs. energy, archeological evidence from the excavations at Ur, a literary account from The Epic of Gilgamesh written c. 2600 BC, and astroblems at various places (Australia, India, and Saudi Arabia) which were created in that century.

PREPARATION AND CHARACTERIZATION OF TRANSPARENT OXIDE CONDUCTING THIN FILMS. Timothy J. Nagle[1], Gerald R. Taylor[1], John Stenger[2], David Lawrence[2], [1]Physics Dept., [2]ISAT, James Madison Univ., Harrisonburg, VA 22807. Transparent conductive thin films are in high demand due to their potential for use in liquid crystal displays, photovoltaic cells, space applications, and other electro-optical devices. Zinc oxide (ZnO) is of particular interest for these applications due to its relative low cost compared with more commonly used indium tin oxide (ITO) thin films. Transparent ZnO thin films were deposited on glass substrates using spin-coating techniques. Properties of the films including electrical resistivity, Hall coefficient, and carrier concentration have been measured. Experimental techniques and measurements will be presented. Also, surface properties measured using atomic force microscopy (AFM) will be discussed.

HOW TO MAKE SINGING RODS SCREAM. D. Rae Carpenter, Jr., Richard B. Minnix & William W. McNairy, Virginia Military Institute, Virginia Military Institute, Duke University. The singing rod has long been a favorite of physics demonstrators. Longitudinal vibrations are easily excited for mode numbers n=1 and n=2 for shorter rods and even higher mode numbers for rods about a meter in length or greater. Aluminum is favored because of its higher Q, or tendency to maintain its resonance with a minimum of damping. Occasionally one finds by chance that an aluminum rod screams when one of the transverse modes becomes coupled to the longitudinal mode as a result of an integer ratio between a natural frequency of the longitudinal and transverse frequencies. Computer software is now available to analyze the various waves emanating from a rod and read out the numerical value of the frequencies. This has made it possible to measure the multiplicity of frequencies present when coupling occurs. In such cases a good comparison between the theoretical and experimental values is possible. Demonstrations, with accompanying data on frequencies and mode numbers, will be provided for rods of both circular and square cross section. Rods of other cross sections are also being investigated.

CAN WORMHOLES BE SUPPORTED BY QUANTIZED FIELDS? Brett E. Taylor, Radford University. Wormhole spacetimes were introduced as solutions to the Einstein field equations in 1988 by Morris and Thorne. This initial work created a burst of work focused on attempting to solve difficulties that were inherent in these spacetimes. In particular, the spacetimes required exotic material to maintain the geometry of the wormholes. This material is considered exotic because at least some observers would see this material having a negative energy density and, in addition, there would need to be a very large tension associated with this material. This talk will focus on determining whether quantized scalar fields might be able to act as this exotic matter.

TIME TRAVEL PHYSICS Tsunefumi Tanaka, Radford University. Time travel is a very popular theme in science fiction shows because it gives twists to otherwise boring story lines. Is it actually possible to go back in time? Many people will say ``no" if they are asked, because of apparent paradoxes caused by time travel. However, from a physicist's standpoint, we need to show whether time travel violates any laws of physics before answering the question. Being able to go back in time means that there exist closed timelike curves (CTCs) in a spacetime. Some solutions of the Einstein field equations contain CTCs. CTCs can also appear in spacetimes with nontrivial topology. Examples of spacetimes with CTCs are described. Some physical mechanisms that might prevent us from going back in time are described. They include the weak energy condition, metric back reaction on the spacetime geometry, quantum fluctuations, and quantum gravity. However, our best answer to the original question is, ``We don't know." This is because these mechanisms work in some cases but not in others. The real physical mechanism that prevents the formation of CTCs is expected to be applicable in all cases.

A PROTOTYPE ELECTRONIC NETWORK SUPPORTING SCIENCE EDUCATION – THE VIRGINIA SCIENCE RESOURCE NETWORK AND ADVISORY COUNCIL. Gerald R. Taylor, Jr.,[1] , Patricia Fishback[2] and David Hagan[2], [1]James Madison University, Harrisonburg, VA, 22807, [2]Science Museum of Virginia, Richmond, VA 23220. The Science Museum of Virginia and the Virginia Academy of Science are partners in developing the Virginia Science Resource Network (VSRN) to help increase the science education of every middle school and high school student in the Commonwealth. A goal of VSRN is to stimulate and facilitate connections between teachers, students and science and engineering experts in Virginia. The Virginia Science Resource Network Advisory Council has been established to review and recommend best practices for VSRN. An overview of VSRN and its new website, VSRN.org, will be presented. Members of the scientific community in universities and industry are encouraged to sign-on to VSRN.org, register and share their enthusiasm for science with teachers and elementary, middle and high school students throughout Virginia.

+LIFETIME: PAST AND FUTURE MEASUREMENTS. Kevin Giovanetti, Physics Department, James Madison University, Harrisonburg, VA 22807. Improved theoretical calculations of the relationship between the muon lifetime, , and the Fermi coupling constant, G_F, allow the extraction of G_F from measurements of the positive muon lifetime with a greatly reduced error. Because G_F is a fundamental constant new measurements of the muon lifetime have been proposed. A review of the challenges associated with a lifetime measurement will be given with examples from past and newly proposed experiments.

Biology

CHARACTERIZING THE FUNCTIONAL AND STRUCTURAL DOMAINS IN *ARABIDOPSIS* CHALCONE ISOMERASE. Chris Dana & Brenda Winkel, Dept. of Biology, Virginia Polytechnic Institute & State University, Blacksburg, VA 25061. Enzyme complexes are groups of two or more enzymes that interact to catalyze related metabolic reactions. The flavonoid biosynthetic pathway of *Arabidopsis* has been developed as a model system for the study of multi-enzyme complexes. The aim of this research project is to characterize the interactions between the first two enzymes of this pathway, chalcone synthase (CHS) and chalcone isomerase (CHI), and to model these interactions in three dimensions. A series of N- and C-terminal truncations of CHI will be used in affinity chromatography experiments with plant extracts to identify domains through which CHI interacts with other flavonoid enzymes. In addition, we have already determined a theoretical model of wild-type and mutant alleles of *Arabidopsis* CHS by homology modeling. We propose to purify, crystallize and solve the crystal structure of CHI for modeling its interactions with CHS. Applying this data to a three-dimensional model of CHI and CHS, we may be able to show how these enzymes work together in a complex. More importantly, the results from these experiments will give us a better perspective on how enzymes work together within the cell.

EFFECTS OF POLLUTANT CHEMICALS ON THYROID HORMONE EXCRETION IN BIRDS. Ryan J. R. McCleary[1], F. M. Anne McNabb[1] & Keith A Grasman[2], [1]Dept. of Biology, Virginia Polytechnic Institute & State University, Blacksburg, VA 24061 and [2]Dept. of Biological Sciences, Wright State University, Dayton, OH 45435. Studies in lab rodents suggest some PCBs and dioxins reduce thyroid function by increasing T_4 glucuronidation and excretion. However, little is known of PCB effects on thyroid function in birds, although wild birds often are exposed to these pollutants in the environment. To assess PCB effects on avian thyroid function, we dosed chicken eggs with PCB 126 (a coplanar, dioxin-like PCB congener) at concentrations of 0, .0512, .128, .32, .48, .64 or .80 ng/g egg prior to incubation. Embryos were sampled at day 20. Plasma T_4 was determined by RIA, and hepatic uridinediphosphate-glucuronosyltransferase (UDP-GT) activity to phenolic compounds was determined by a *para*-nitrophenol assay validated for use with avian tissue. Neither plasma T_4 concentrations nor hepatic UDP-GT activities were significantly different from controls in any dosed group, indicating that thyroid function in chicken embryos was not altered by PCB 126 exposure throughout development. Before generalizing about PCB effects on thyroid function, more research is needed to elucidate possible effects of other PCB congeners, different exposure times and different developmental ages. Supported by EPA grant #R 827400-01-0.

PHYSICALLY COMPLEX HABITAT AND BENTHIC INVERTEBRATE COMMUNITY PARAMETERS: MATHEMATICAL RELATIONSHIPS IN THE JAMES RIVER. T.W. Stewart, T. Shumaker, & T. Radzio, Dept. of Natural Sciences, Longwood College, Farmville, VA 23909. Physical structure generally stimulates increased organism abundance and diversity by providing refuges from disturbance. However, mathematical relationships (i.e., linear or nonlinear) between physical structure abundance and organism abundance and diversity are poorly described. We show evidence that freshwater bottom-dwelling invertebrates respond positively to physical structure, and present preliminary results from an investigation of mathematical relationships between physical structure abundance and invertebrate abundance and diversity. Contrary to our hypotheses that high densities of physical structure are required to elicit a biological response, invertebrate abundance and diversity were greater at low levels of physical structure (10% of cement block covered with stones) than when no structure was present ($p \leq 0.05$). Our results will contribute to an improved understanding of biological community responses to changes in physical structure abundance that is needed to predict effects of habitat loss or gain on biological diversity.

CLONING AND ANALYSIS OF TRANSCRIPTIONAL REGULATION OF THE 5'NUCLEOTIDASE GENE IN *DICTYOSTELIUM DISCOIDEUM*. Can M. Eristi & Charles L. Rutherford, Dept. of Biology, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061. A 5'AMP-degrading activity appears during the time course of cell differentiation in *Dictyostelium discoideum* and the activity becomes restricted to a narrow band of cells that form the interface between the two differentiated cell types. The gene is referred as *5' nucleotidase* or *5'NT* . The expression of this gene occurs during the formation of the multicellular slug stage. The sorting of specific cells expressing 5'NT to form a boundary between the prespore and prestalk zones suggests that this activity is essential to positional differentiation of the two cell types. An understanding of the regulation of the expression of this protein is required before an accurate model of the mechanisms that regulate morphogenesis can be constructed. A genomic fragment containing a part of the 5'NT coding as well as an upstream flanking region has been cloned. Promoter deletions have been generated using an exonucleaseIII-mung bean nuclease system. Regulatory elements responsible for the cell-specific expression of this gene will be defined by use of the luciferase reporter gene system. Gel mobility shift assays will also be performed to identify trans-acting factor(s) that bind specifically to those elements.

SPERM COMPETITION AS A MECHANISM FOR SEXUAL SELECTION IN THE LIZARD, *ANOLIS CAROLINENSIS*. Kelly M. Passek, Dept. of Biology, Virginia Polytechnic Institute & State University, Blacksburg, VA 24061. Sperm competition is one mechanism by which competition over mates occurs. It has been defined as competition between the sperm of two or more males to fertilize the eggs of a female during one reproductive cycle. Given the life history characteristics of the lizard, *Anolis carolinensis*, sperm competition is a plausible mechanism for sexual selection. Sperm competition can be evidenced through the occurrence of multiple paternity. Does a resident male father all of the hatchlings born to females whose territory he patrols? Resident males, females from within their territories and neighboring males were collected. One to two eggs collected from each female were incubated until hatching. Paternity analysis using RAPD-PCR was performed to determine the paternity of each hatchling. Using the presence of diagnostic bands as an indicator of paternity, I found evidence of neighboring males fathering six of 18 hatchlings. In light of this documentation of multiple paternity, I am interested in determining if male territory size or location of resident females within a male's territory influences the occurrence of multiple paternity.

EFFECT OF INTERLEUKIN-10 ON THE FREQUENCY OF PREGNANCY LOSS INDUCED BY LIPOPOLYSACCHARIDE INJECTION IN CD-1 MICE. Kristin L. Hriniak[1], Carolyn M. Conway[2], & Arthur F. Conway[1], [1]Dept. of Biol., Randolph-Macon Coll., Ashland, VA 23005 & [2]Dept. of Biol., VCU, Richmond, VA 23284. Pregnant female CD-1 mice were injected intraperitoneally with 2.5 g recombinant mouse interleukin-10 (IL-10) twelve hours prior to lipopolysaccharide (LPS) injections, injected intravenously with 5 g LPS on day 9 of gestation (plug = day 1), and sacrificed on day 12 of gestation. Control females were injected with phosphate-buffered saline (PBS) in place of IL-10 and/or LPS. IL-10 treatment significantly decreased the frequency of pregnancy loss in LPS-treated females. A second set of mice were left untreated, injected with PBS, or injected with LPS as above and sacrificed six hours later for ELISA analysis of IL-10 concentrations in maternal serum and in implantation sites from LPS-treated mice. Although IL-10 concentrations in maternal serum were increased in LPS-injected mice, no changes in IL-10 concentrations were observed in the regions sampled in implantation sites. These results indicated that although injecting IL-10 in excess of normal levels can inhibit LPS-induced pregnancy loss, no changes in intrinsic IL-10 concentrations in implantation sites were associated with the early stages of LPS-induced pregnancy loss.

MODULATING FLAVONOID BIOSYNTHESIS IN TRANSGENIC *ARABIDOPSIS*. Michael C.O. Santos & Brenda S.J. Winkel, Dept. of Biology, Virginia Polytechnic Institute & State University, Blacksburg VA 24061. We are testing the feasibility of altering a metabolic pathway in transgenic plants by using antibodies that recognize the pathway's key enzymes. Thus, we have attempted to overexpress antibodies in the single-chain fragment format (ie scFv) that recognize either of the first two enzymes of the flavonoid biosynthetic pathway (ie chalcone synthase: CHS, chalcone isomerase: CHI) in Arabidopsis. Our efforts have resulted in a minimum of 10 independent transgenic lines per unique anti-CHS or -CHI scFv. We are now screening all homozygous lines for scFv-expression by immunoblot analysis. In addition, we are looking at flavonoid composition by HPLC analyses of methanolic extracts from transgenic plants grown on flavonoid metabolism-inducing medium. Thus far, we have identified a low-level anti-CHS scFv expressor that has a significantly altered profile for glycosylated kaempferol and quercetin, flavonoid compounds detectable at 255 nm. These preliminary results are, to our knowledge, the first to demonstrate that scFv-expression is a potentially useful strategy for *in vivo* modulation of metabolism in transgenic plants.

CHANGES IN GUT MORPHOLOGY AND PHYSIOLOGY OF TWO *MICROTUS* SPECIES UNDER DIFFERING PHOTOPERIODS AND DIETARY FIBER LEVELS. Scott Buchanan & Jack A. Cranford, Dept. of Biology, Virginia Polytechnic Institute and State University, Blacksburg, VA 25061. We subjected meadow voles (*Microtus pennsylvanicus*) and prairie voles (*M. ochrogaster*) to high (50% NDF) and low (5% NDF) dietary fiber levels and long (16L:8D) and short (8L:16D) photoperiods for 20 days. Animals were then euthanized and dissected and the mass, length, and content mass of the stomach, caecum, and small and large intestine were measured. Food intake rate and feces produced increased significantly ($p<0.01$) and digestive efficiency percentage decreased significantly on high-fiber treatments for both species. Retention time did not vary significantly between trials. GI tract mass decreased under short photoperiod for prairie voles, but not for meadow voles. There were no differences in gut mass between species on long and short photoperiod regardless of dietary fiber level. We assert that voles may compensate for low-quality diets by increasing intake rate and decreasing digestive efficiency in order to maintain retention time.

THE EFFECTS OF PHOSPHATE DEFICIENT MEDIUM ON CELL SIZE, CYANOPHYCIN GRANULE FORMATION, NITROGENASE ACTIVITY, PHOTOSYNTHETIC PIGMENT FORMATION, AND GENOME ARRANGEMENT DURING AKINETE DIFFERENTIATION IN *ANABAENA AZOLLAE*. Stephanie M. Carter, Dept. of Biology, Virginia State University, Petersburg, VA 23806 & Robert W. Fisher, Dept. of Biology, Virginia Commonwealth University, Richmond, VA 23284. The purpose of this research was to identify the structural, biochemical and genetic changes that occur during vegetative cell differentiation to akinete cells in the cyanobacterium *Anabaena azollae* Stras. Results were determined through a series of experiments: 1. Structural changes were studied by calculating the surface area of cells and changes in cyanophycin granule accumulation; 2.Biochemical changes were observed through monitoring phycobiliprotein and chlorophyll *a* concentrations and by monitoring nitrogen fixation by using the Acetylene Reduction Assay (ARA); and 3. Genetic changes were monitored through DNA isolation and characterization. The end results showed that granule accumulation and cell size increased while phycobiliprotein and chlorophyll *a* concentrations declined. Nitrogenase activity gradually decreased due to the lack of heterocyst differentiation. Supported in part by NIH grant # 1E25GM56620-01.

IMMUNOLOCALIZATION OF TWO FLAVONOID ENZYMES IN *ARABIDOPSIS*. David Saslowsky & Brenda Winkel, Dept. of Biology, Virginia Polytechnic Institute & State University, Blacksburg, VA 24061. The enzymes of certain metabolic pathways, such as glycolysis and the citric acid cycle, have been shown to function as multicatalytic complexes, or metabolons. Such organization offers a number of potential advantages with respect to metabolic efficiency, kinetics, and regulation. The research interest of our laboratory is to determine if the enzymes of the flavonoid biosynthetic pathway exist as a cytosolic enzyme complex, and how such organization impacts metabolic regulation. Immunolocalization of the first and second flavonoid enzymes, chalcone synthase (CHS) and chalcone isomerase (CHI), respectively, is being used to determine if a flavonoid metabolon exists in Arabidopsis. In wild type (Landsberg) seedling roots, CHS and CHI exhibit cell type-specific co-localization around vacuoles and at the endoplasmic reticulum (ER). In a mutant (*tt*7) devoid of a pathway integral membrane protein (F3'H), CHS and CHI display tissue-specific localization patterns distinct from that of wild type, although subcellular localization patterns seem to be unaffected. Localization near the vacuole is logical as flavonoid end products are transported into this organelle.

ANALYSIS OF cAMP INDUCED NEUROENDOCRINE DIFFERENTIATION IN HUMAN PROSTATIC ADENOCARCINOMA CELL LINE LNCaP USING mRNA DIFFERENTIAL DISPLAY. Jeremy L. Goodin & Charles L. Rutherford, Dept. of Biology, Virginia Polytechnic Institute & State University, Blacksburg, VA 24061. Prostate cancer is the second leading cause of cancer related death among men and the most commonly diagnosed cancer in the Western world. It has been demonstrated that LNCaP prostate cancer cells can be induced to differentiate from a growing epithelial morphology to a growth arrested neuroendocrine (NE) state by increased levels of intracellular cAMP. Elucidation of those genes that are differentially expressed between growing epithelial cells and LNCaP cells that have been induced to NE differentiation may present new insights for the early detection of prostate cancer and/or targets for effective gene therapy. In order to determine the molecular events underlying the effects of cAMP on these prostate cancer cells, we have used a new and powerful technique called Differential Display PCR to identify a number of differentially expressed genes. To date, eleven PCR products have been confirmed by northern blot analysis to be differentially expressed. The differentially expressed PCR products have been cloned and sequenced. Resultant sequences have been tested for homology to known sequences in public databases. Expression of the genes for HRS3A protein and ATP synthase subunit g were found to be down regulated in NE cells and may play an important role in prostate cancer progression.

EFFECT OF INDOMETHACIN TREATMENT ON PROSTAGLANDIN E_2 AND F_2 CONCENTRATIONS IN MATERNAL SERUM AND PERI-EMBRYONIC TISSUES OF IMPLANTATION SITES IN CONTROL AND LIPOPOLYSACCHARIDE-TREATED CD-1 MICE. James E. Urban[1], Carolyn M. Conway[2], & Arthur F. Conway[1], [1]Dept. of Biol., Randolph-Macon Coll., Ashland, VA 23005 & [2]Dept. of Biol., VCU, Richmond, VA 23284. Mice were given 6 g/ml indomethacin (IND) or plain drinking water from day 7 to day 9 of gestation (plug = day 1), then injected with lipopolysaccharide (LPS) or with phosphate-buffered saline (PBS) or left untreated on day 9 of gestation. Mice were sacrificed 6 hours after day 9 treatment and implantation sites were frozen for ELISA analysis of prostaglandins F_2 (PGF_2) and E_2 (PGE_2). IND treatment reduced both PGE_2 and PGF_2 concentrations in maternal serum and in all regions sampled in implantation sites and resulted in a reduction in the ratio of PGE_2 to PGF_2, but LPS treatment had no effect. The reduction in PGF_2 concentration was consistent with IND treatment preventing pregnancy loss in LPS-treated mice by inhibition of inflammatory prostaglandin synthesis, but the failure to observe elevation (relative to control mice) of PGF_2 concentrations in LPS-treated females not treated with IND argued strongly against involvement of increased PGF_2 concentrations in LPS-induced pregnancy loss.

SURVIVAL AND PHENOTYPES OF HATCHLING LIZARDS. Daniel A. Warner & Robin M. Andrews, Dept. of Biology, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061. Environmental conditions during egg incubation affect phenotypes of hatchling reptiles. However, the ecological significance of incubation induced phenotypes is poorly known. We investigated such effects for hatchlings of the lizard *Sceloporus undulatus*. Eggs from 28 clutches were incubated under two moisture regimes (-150 kPa and -530 kPa) at a constant 28 C. Yolk was removed from eggs to manipulate hatchling body size in a third treatment. After hatching, snout-vent length, mass, tail length, growth rate, thermal preference, running performance, and desiccation rate were measured for each hatchling. Hatchlings were then released at the field site near Blacksburg, Virginia and monitored for 12 weeks. In both the laboratory and field, most variation in hatchling phenotype was explained by clutch; treatment had no affect after correcting for body size. For example, survival was related to clutch, and variation in survival was associated with growth rate. Hatchlings that survived longer than six weeks grew slower than those that did not survive to six weeks. If rapid growth is associated with high activity, the more rapidly growing hatchlings may be more conspicuous to predators. In general, our observations demonstrate the importance of maternal contributions to offspring fitness.

DIOXIN-INDUCED ALTERATION OF THYROID HORMONE METABOLISM IN MICE. J. E. Baumgartner, F. M. A. McNabb, I. A. Camacho & M. Nagarkatti, Dept. of Biology, Virginia Polytechnic Institute & State University, Blacksburg, VA 24061. The effects of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) on uridinediphosphate-glucuronosyltransferase (UDP-GT) were studied in C57BL6+/+ mice, a TCDD-sensitive species. In rats, TCDD increases thyroxine (T_4) glucuronidation and excretion, but the effects of TCDD on UDP-GT in mice have not been investigated. We measured hepatic UDP-GT spectrophotometrically at 400 nm as the decolorization of *para*-nitrophenol substrate. The assay was validated by establishing conditions that gave linearity with reaction time and with tissue concentration. UDP-GT activity did not change after one day of exposure to a single dose of any TCDD amount used (.1, 1.0, 10 or 50 μg/kg body weight vs. corn oil injected controls). At 5 days of exposure, UDP-GT activity increased linearly with TCDD dose when compared to controls. Responses of males and females did not differ. Hepatic UDP-GT was increased significantly above controls at 14 and 21 days of TCDD exposure but activity was highest at 5 days after injection with the 50 μg/kg dose. These results show that TCDD induces a dose dependent increase in UDP-GT activity, which should result in increased T_4 glucuronidation and excretion. If T_4 production is insufficient to balance increased excretion this could result in decreased circulating T_4 and a hypothyroid state. Supported by EPA grant #R 827400-01-0.

SEASONAL VARIATIONS IN THE PHYTOPLANKTON COMMUNITIES OF AN EPHEMERAL SINKHOLE COMPLEX, YORK COUNTY, VIRGINIA. Michelle R. Kokolis, Dept. of Biological Sciences, Old Dominion University, 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, which are filled seasonally by precipitation and groundwater discharge. These ponds 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. The first phase of this study was to examine the physical and chemical characteristics of several of these ponds, including pond size and depth, canopy openness, inundation period, water temperature, and pH. The second phase was to examine the phytoplankton assemblages of the selected ponds, and correlate differences in the phytoplankton assemblages to the varying physical and chemical characteristics of the ponds. Analysis indicates the occurrence of spring and early fall Chlorophyte and Cyanobacteria blooms and a winter Dinoflagellate bloom. Diatoms are a secondary component of the phytoplankton community.

MONITORING ENZYME-ENZYME INTERACTION IN THE PLANT FLAVONOID BIOSYNTHETIC PATHWAY USING FLUORESCENCE RESONANCE ENERGY TRANSFER. Anna M. Leung & Brenda S.J. Winkel, Dept. of Biology, Virginia Polytechnic Institute & State University, Blacksburg, Va 24061. The flavonoid biosynthetic pathway of *Arabdopsis* is being used as a model system for the study of enzyme complexes. My project involves studying the interaction between chalcone synthase (CHS) and chalcone isomerase (CHI), the first two enzymes in this pathway. We are exploring the feasibility of using fluorescence resonance energy transfer (FRET) to detect these interactions, first in *Escherichia coli* and eventually in live *Arabidopsis* plants. FRET is a process where an excited fluorophore transfers excitation energy to a light-absorbing molecule. FRET occurs only if distance and mutual orientations of the proteins are suitable. FRET was used to detect interactions between CHS and CHI by fusing these enzymes to enhanced cyan fluorescence protein (ECFP) and enhanced yellow fluorescence protein (EYFP). These fusion proteins were placed into bacterial expression vectors and then coexpressed in *E. coli* strain BL21 (DE3). FRET was not detected in preliminary experiments due to a variety of external factors. Additional experimentation will be needed before conclusive results can be obtained.

EFFECTS OF CHRONIC UNPREDICTABLE STRESS ON LEVELS OF INNATE AND IMMUNE DEFENSE COMPONENTS IN UNSTIMULATED AND LIPOPOLYSACCHARIDE-STIMULATED RATS. Melissa D. Derr[1], Kelly G. Lambert[2], & Arthur F. Conway[1], [1]Dept. of Biol. & [2]Dept. of Psych., Randolph-Macon Coll., Ashland, VA 23005. The effects of chronic stress on innate and immune components were studied in Long-Evans rats by exposing the rats to an eleven-day stress protocol, then injecting the rats subcutaneously with 50 g of bacterial lipopolysaccharide (to simulate a Gram-negative bacterial infection) or with phosphate-buffered saline, and then sacrificing the rats approximately six hours after injection. Chronically stressed rats gained significantly less weight than control rats and had significantly smaller adrenal glands, indicating that the stress protocol was sufficient to cause physical changes. Thymus and spleen weights, serum IgG and TNF alpha concentrations, and percentages of lymphocytes, monocytes, and neutrophils among white blood cells were not significantly altered by chronic stress. Chronic stress significantly inhibited the increases in percentages of basophils and eosinophils among white blood cells which occurred in response to lipopolysaccharide, suggesting that innate responses to protistan and helminth parasites might be compromised in stressed animals.

THE NEANDERTAL'S ROLE IN HUMAN HISTORY. Wendy L. Skinner & David A. DeWitt, Dept. of Biology & Chemistry, Liberty University, Lynchburg, VA 24502. MtDNA has been used to infer migration patterns and establish dates of divergence of common ancestors in human evolution. Such results have promoted the 'Out of Africa' model whereby early modern humans evolved in Africa and then migrated to Europe replacing the Neandertals. Recent reports yielding the sequence of HVRI and HVRII mtDNA regions from fossil Neandertals have been interpreted to support this model and as evidence that Neandertals were outside the range of modern human variability. However, these regions are known to have an extremely high rate of mutation. Further, 12 out of 19 reported sites of Neandertal pairwise nucleotide differences in HVRI are at sites known to be 'hot spots' with a high relative muation rate. In addition, one of the Neandertals exactly matches the human reference sequence at 100% of intra-Neandertal pairwise difference sites. We examined HVRII in 143 modern humans and found an average of 8.6 differences. The 14 modern individuals with the most pairwise differences (12-14) surprisingly shared 2-7 of these differences with the Neandertal when compared to the human reference sequence. Taken together, these results suggest that Neandertals cannot be excluded from the normal range of human variability and alternatives to the "Out of Africa" model cannot be ruled out.

THE FEVER RESPONSE IN THE GARTER SNAKE (*THAMNOPHIS RADIX RADIX*): THE RESPONSE TO A WHOLE BODY INFECTION COMPARED TO A LOCALIZED INFECTION. Elana Pressman & John Temple, Dept. of Biological Sciences, Mary Washington College, Fredericksburg, VA 22401. A fever is an increase in body temperature resulting from an elevation in the thermoregulatory set point. As ectotherms, snakes may behaviorally induce a fever by moving to a warmer location. This experiment compared thermoregulatory patterns in snakes given whole body infections to patterns in snakes given localized infections. For the whole-body infection, saline was injected intraperitoneally (IP), followed 48 hours later with an IP injection of alcohol-killed *Aeromonas hydrophila* bacteria. For the localized infection, saline was injected subcutaneously (SC) 2 cm anterior to the cloaca, followed 48 hours later with a SC injection of the bacteria. Following each injection, snakes were given access to a thermal gradient and the cloacal temperature and body position were recorded for 48 hours. The snakes given a whole-body infection significantly increased their body temperature by an average of 4.33% in the first 24 hours following injection of bacteria. No other significant temperature change was noted. There were no apparent differences between thermoregulatory patterns of snakes with whole body infections compared to those with SC infections.

ELECTROPORATION MEDIATED GENE TRANSFER USING INTACT PLANT TISSUE. Lou V. Garcia, NIH Bridges Program, Science Dept., J. Sargeant Reynolds Community College, Richmond, VA 23285 & Fang-Sheng Wu, Dept. of Biology, Virginia Commonwealth University, Richmond, VA 23284. The purpose of this research was to study the effectiveness of electroporation for DNA uptake into plants for studies of transient gene expression and for stable transformation. Electroporation has been found to be effective on many types of cells, and is now the method of choice for the genetic transformation of bacteria and certain animal cells. It has been shown to be a simple, fast, inexpensive, and non-toxic procedure to deliver DNA into protoplasts derived from a variety of plants. Plasmid DNA can be effectively delivered into intact plant cells and expressed at transient levels and can be used to obtain stably transformed plants by direct gene transfer into intact plant cells. The authors thank both JSRCC and VCU for their support of the NIH Bridges Program. The study was funded in part by NIH grant #1E25GM56620-01.

ACTIVATION OF p21 BY ESTRADIOL AND TAMOXIFEN AND SUBSEQUENT EFFECTS ON DNA DAMAGE REPAIR. David R. Chaves & Rosemary Barra, Dept. of Biological Sciences, Mary Washington College, Fredericksburg, VA 22401. Expression of the cyclin-dependent kinase inhibitor p21 elicits a G1 phase arrest and prevents replication of damaged DNA. In addition, p21 may play a role in a cell's ability for nucleotide excision. Various hormones are known to act as transcription factors and to induce regulators of the cell cycle. This study demonstrates the effects of dexamethosone, estradiol, and tamoxifen on p21 production and DNA repair sensitivity in response to UV radiation and methyl methane sulfate induced damage. The experiments were conducted in ME-180 cells and the results indicate that estradiol and tamoxifen treatments increase p21 production. Cells treated with estradiol had an elevated capacity for nucleotide excision repair compared to control groups following exposure to UVC. Tamoxifen may have a similar effect. These results demonstrate a correlation between p21 production and nucleotide excision repair, and they also help to explain some of the known cancer preventative effects of estradiol and tamoxifen. MMS treatments did not produce the same results as UV radiation. Hormonal treatments in those experiments did not result in higher levels of DNA repair. This suggests that there may be differences in the role of p21 in MMS and UV induced DNA damage repair pathways.

CHARACTERIZATION OF A NUCLEAR LOCALIZED CAMK – II ISOZYME. [1]Nicai Q. Zollar, [2]Kim Jenkins, [3]Lesley Johnson, & [2,3]Robert Tombes, [1]NIH Bridges Program, Science Dept., J. Sargeant Reynolds Community College, Richmond, VA 23285 & [2]Massey Cancer Center & [3]Dept. of Biology, Virginia Commonwealth University, Richmond, VA 23284. CaM kinase II, the "multi-functional" Ca2+/CaM-dependent protein kinase (CaMK-II), is encoded as over two dozen splice variants through combinations of at least ten separate splice domains from 4 different genes. There is evidence that these domains target CaMK-II isozymes to intracellular locations. This work is an on going project to determine the cellular physiology of a targeting CaMK-II to the nucleus. The isozyme used in this study is a nuclear targeted variant of Beta CaMK-II linked to green fluorescent protein (GFP). When expressed in NIH/3T3 fibroblasts, this isozyme localizes within the nucleus and induces cell death over the course of three days. This study was funded in part by NIH grant #1E25GM56620-01.

AN ANALYSIS OF THE EFFECTS OF SEROTONIN DEPLETION ON COORDINATION, LOCOMOTION, AND RIGHTING TIME IN RAT SNAKES (GENUS *ELAPHE*). Russell Lederhouse & John Temple, Dept. of Biological Sciences, Mary Washington College, Fredericksburg, VA 22401. Past research has indicated that depletion of central dopamine (DA) and/or serotonin (5-HT) causes movement disorders in the black ratsnake *Elaphe o. obsoleta*. In this study the biochemical and behavioral effects of *para*-chlorophenylalanine (pCPA), a drug which reduces 5-HT, was tested in cornsnakes *Elaphe g. guttata* in order to specifically address the role of 5-HT in movement control. An intraperitoneal dose of 100 mg/kg/day pCPA was administered for eight days and righting time was measured. Righting time was significantly decreased by the drug treatment. pCPA significantly decreased 5-HT in the forebrains (79.6%) while having a suggestive effect on the depletion of 5-HT in the mid (67.1%) and hindbrains (60.3%), and on DA in fore (64.6%) and midbrains (72.3%) as well. It was also observed that some of the pCPA treated snakes appeared dazed and unable to right themselves until stimulated by touch, then resumed normal righting ability. This experiment showed that pCPA significantly impairs righting times in ratsnakes. However, it remains uncertain if the observed responses are due solely to 5-HT depletion or to concomitant depletion of 5-HT and DA.

GRAY LEAF SPOT: MOLECULAR ANALYSES OF *CERCOSPORA ZEAE-MAYDIS* STRAINS FROM MIDATLANTIC AND MIDWESTERN REGIONS OF THE UNITED STATES AND SOUTH AFRICA. Georgia A. Hammond[1], Verlyn K. Stromberg[2], Eric L. Stromberg[2] & George H. Lacy[2], [1]Dept. of Biol., Radford Univ. & [2]Dept. of Plant Pathology, Phsiology & Weed Science, VPI&SU. *Cercospora zeae-maydis* (*Czm)* is the fungus causing Gray Leaf Spot (GLS) disease of maize *(Zea mays*). Types I and II *Czm* have been identified in the US. These types show sequence variation in the Internal Transcribed Spacer regions (ITS) of their ribosomal RNA genes. In order to design maize breeding programs aimed at developing resistance to the pathogen; it is essential to ascertain which *Czm* populations cause GLS in a given region. The goals of our research are: (1) to confirm the existence of Type I and Type II *Czm* by extending the DNA sequence analyses to the small subunit ribosomal RNA gene (ssrRNA); (2) to determine the number of differing *Czm* genotypes extant in the US and their distributions; and (3) to extend our analysis of fungal genotypes to include foreign strains. Leaves with lesions were collected, air-dried, and imported into Virginia (APHIS PPQ permit). Fungi grown on V8 agar were extracted for DNA. PCR-amplified ssrRNA genes and ITS regions were sequenced and compared with the corresponding sequences from *Cercospora beticola*, *C. sorghi*, *Pseudocercospora mali*, *P. musae*, *Mycosphaerella pomi* and *M. zeae-maydis.* Our results indicate species-level differences between between Type I and II *Czm* strains. Our results demonstrate the presence of both Type I and Type II *Czm* in Virginia, and Type II *Czm* in the Republic of South Africa. Preliminary comparisons of small subunit rRNA sequences suggest the existence of a third *Czm* genotype in Virginia.

DETECTION OF THE EPINEPHRINE SYNTHESIZING ENZYME IN MOUSE SPLEEN AND THYMUS. Carolene W. Lewis[1], Michelle D. Wharthan[2], Jessica G. Freeman[2] & Jennifer K. Stewart[2], [1]NIH Bridges Program, Science Dept., J. Sargeant Community College, Richmond, VA 23285 & [2]Dept. of Biology, Virginia Commonwealth University, Richmond, VA 23284. MRNA coding for the epinephrine synthesizing enzyme phenylethanolamine N-methyl transferase (PNMT) was localized in the mouse spleen and thymus with *in situ* hybridization. PNMT activity was measured radioenzymatically. Both PNMT activity and mRNA were barely detectable in the spleen of the mouse. However, levels of PNMT activity in the thymus were similar to those in the brainstem, and PNMT mRNA was distributed throughout the cortex and medulla of the thymus. (Supported by NSF grant 9870382 and NIH grant #1E25GM56620-01.)

INDUCTION OF NT2 CELL DIFFERENTIATION BY THE MOUSE CAUDATE PUTAMEN. B.R. Monroe & D.A. O'Dell, Dept. of Biology, Mary Washington College, Fredericksburg, VA 22401. A human embryonic carcinoma cell line (NT2 cells), can be induced *in vitro* to differentiate into neuron-like cells by the application of retinoic acid. Once differentiated, the NT2N cells lose their tumorgenicity, and have been used in studies that examine neural plasticity, cell transplantation, and the functional repair of the nervous system. NT2 cells, when injected into immunodeficient mice, rapidly form lethal tumors, except when injected into the caudate putamen. This suggests that retinoic acid is present in this region and acts by differentiating the NT2 cells into non-tumorgenic NT2N cells. It has been demonstrated that retinoic acid is present in the retina, cerebellum, and many locations throughout the fetus, but its presence in the adult caudate putamen had not been determined. Through the use of tissue culture and HPLC we attempted to determine whether retinoic acid or some other factor was responsible for the differentiation. The results indicated the presence of 4.40×10^{-5} +/- 1.19×10^{-5} M all-trans-retinoic acid in the mouse caudate putamen. This concentration is far greater than the amount needed to induce NT2 cell differentiation *in vitro* (1×10^{-5} M). Thus, retinoic acid is present in the adult mouse caudate putamen in sufficient amounts to suppress tumor formation by NT2 cells.

CHARACTERIZATION AND IDENTIFICATION OF Q-LIKE ELEMENTS IN *A. STEPHENSI.* Landon Edwards & Shirley Luckhart, Dept. of Biochemistry, Virginia Polytechnic Institute & State University, Blacksburg, VA 24061. Transposable elements (TEs) are self-propagating DNA sequences found in the genomes of both eukaryotes and prokaryotes. TEs replicate through DNA or RNA intermediates; the latter are called retroposons and are related to retroviruses. Retroposons are classified into "viral" or "nonviral" superfamilies based on structural features. One such nonviral retroposon, a Q-like element, was characterized from the African malaria mosquito *Anopheles gambiae*. The authors of this work proposed that the SE Asian malaria mosquito, *A. stephensi*, did not harbor Q-like elements based on DNA hybridization studies. We have discovered, however, that Q-like elements reside in the *A. stephensi* genome and have attempted to characterize and identify the elements through methods involving Universal PCR, Vector Anchored PCR, and Restriction Digestion and comparison of clones.

MOLECULAR PHYLOGENETICS OF *CENTELLA* (APIACEAE). Paola A. Moncada[1], Jason Noel[2], Gregory M. Plunkett[2], Ben-Erik van Wyk[3], & Mahalia Schubert[3], [1]NIH Bridges Program, Science Dept., J. Sargeant Reynolds Community College, Richmond, VA 23285, [2]Dept. of Biology, Virginia Commonwealth University, Richmond, VA 23284, & [3]Rand Afrikaans University, Johannesburg, South Africa. *Centella* is a genus of 40 species distributed throughout the world, with the greatest diversity in southern Africa. We studied 27 different species of *Centella* using DNA sequences of the internal transcribed spacers (ITS) of the nuclear ribosomal RNA genes. After phylogenetic analysis of these ITS sequences, we conclude that all 27 species sampled from *Centella* form a single evolutionary branch or "clade," so that *Centella* is said to be monophyletic. The earliest lineage to diverge in *Centella* was *C. asiatica*, a species that is distributed throughout the world. The next to diverge were *Centella glabrata* and *C. fusca*. Resolving relationship among the remaining African species will require additional molecular markers. This study was funded in part by NIH grant #1E25GM56620-01.

QUANTITATIVE DETERMINATION OF THE COMPOSITION OF SOUTHERN TOAD (*BUFO TERRESTRIS*) VENOM AND ITS METABOLISM BY SNAKE BLOOD. Kimberly Parker & John Temple, Dept. of Biological Sciences, Mary Washington College, Fredericksburg, VA 22401. Toads (Genus *Bufo*) are known to emit potent compounds from their skin glands as a means of defense. The secretions include cardioactive glycosides and monoamines including serotonin and its structural analogues. One goal of this study was to determine the relative amounts of the monoamines in *Bufo terrestris* venom. Venom from the parotoid glands of the toad *Bufo terrestris* was extracted and analyzed using high performance liquid chromatography (HPLC). Serotonin (82.5 mg/g) and N-methyl serotonin (1.5 mg/g) were found in the venom, as well as one currently unidentified peak. These results demonstrate that serotonin is more abundant than N-methyl serotonin in *Bufo terrestris* venom. The second goal of this study was to develop an assay to measure monoamine metabolism in the blood of bufophagous and non-bufophagous snake species. Results indicate that blood samples must be centrifuged at 15,000 X g for 30 minutes in order to reduce the artifactual release of serotonin from platelets. These methods will be incorporated into future studies to determine the comparative metabolism of toad toxins by snake blood.

AN ASSAY OF NEURONAL GROWTH DURING LEARNING IN *DROSOPHILA*. Cathrine L. Dam & Deborah A. O'Dell, Dept. of Biology, Mary Washington College, Fredericksburg, VA 22401. Learning in three types of *Drosophila* was analyzed through classical conditioning and protein analysis. Each group of flies, wild-type, *rutabaga* and *dunce*, were trained to associate an odor with sucrose in a learning apparatus. The analysis involved calculating a learning index of the fraction of flies choosing the positive conditioned stimulus (CS+) minus the fraction of flies choosing the negative conditioned stimulus (CS-). The learning index as well as the raw data indicate that conditioned wild-type and *dunce* are able to distinguish between odors. On the other hand, *rutabaga* did not appear to learn. The biochemical analysis indicated that trained wild-type formed the highest level of GAP-43 (growth-associated protein-43), a protein associated with learning. Consequently, the cAMP-impaired mutants may be incapable of learning due to an inability to form GAP-43. This project was supported by the Undergraduate Research Fund.

CHARACTERIZATION OF AKINETE GERMINATION AND GERMLING DEVELOPMENT IN THE CYANOBACTERIUM *ANABAENA AZOLLAE*. Bridget D. Wilson, NIH Bridges Program, Science Dept., J. Sargeant Reynolds Community College, Richmond, VA 23285 & Robert W. Fisher, Dept. of Biology, Virginia Commonwealth University, Richmond, VA 23284. The objective of this research project was to monitor the changes that take place during akinete germination and filament proliferation in the nitrogen-fixing cyanobacterium *Anabaena azollae.* We induced akinete differentiation using phosphate free medium and used these akinetes for our studies. We monitored the following characteristics: cell size (with calculated surface area), granule accumulation, cells per filament, chlorophyll a (chl a) and phycobiliprotein concentrations, and nitrogen-fixation (determined by the acetylene reduction assay). The results indicate that as akinetes germinate and filaments begin to grow, the cells get smaller, the granules disappear, the cells per filament increase, chl a and biliproteins increase, and nitrogen-fixation is initiated. Future studies will focus on heterocyst differentiation and DNA changes that take place during akinete germination and subsequent filament growth. The authors thank both JSRCC and VCU for their support of the NIH Bridges Program. This study was funded in part by NIH grant #1E25GM56620-01.

ANALYSIS OF A NOVEL DNA-MEDIATED TRANSPOSABLE ELEMENT IN THE YELLOW FEVER MOSQUITO AND EVIDENCE FOR A DISTINCT GROUP OF TC3-LIKE TRANSPOSONS IN DIVERSE ORGANISMS. Hongguang Shao & Zhijian Tu, Dept. of Biochemistry, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061. A novel transposable element, named *Tc3-Aa*, has been discovered in the yellow fever mosquito *Aedes aegypti*. This 1592 bp transposon contains 36 bp terminal inverted repeats and a 987 bp open reading frame (ORF) separated by a 96 bp intron. The ORF codes for a transposase that is highly similar to that of the *Tc3* of *C.elegans*. There are approximately 150 copies of *Tc3-Aa* elements in the genome of *A.aegypti*. Five out of the 8 sequenced *Tc3-Aa* elements were full-length. Sequence comparisons between these elements showed 98.4-98.9% identity at the nucleotide level, suggesting that *Tc3-Aa* is either currently active or was recently active in *A.aegypti*. Therefore *Tc3-Aa* may have the potential to be used as a transformation tool. Database analysis revealed a previously unidentified *Tc3*-like element in *Drosophila melanogaster*, which we named *Tc3-Dm*. Phylogenetic analysis suggests that *Tc3-Aa, Tc3-Dm,* and *Tc3* of *C.elegans* formed a divergant yet distinct clade in the *Tc1* superfamily.

ACTIVE FE-CONTAINING SUPEROXIDE DISMUTASE AND ABUNDANT *SODF* MRNA IN *NOSTOC COMMUNE* (CYANOBACTERIA) AFTER YEARS OF DESICCATION. Breann L. Shirkey, Don Paul Kovarcik, Deborah J. Wright, Gabriel Wilmoth, Todd F. Prickett, Richard F. Helm, Eugene M. Gregory & Malcolm Potts, Dept. of Biochemistry & Virginia Tech Center for Genomics, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061. Active Fe-superoxide dismutase (SodF) was the third most abundant soluble protein in cells of *Nostoc commune* CHEN/1986 after prolonged (13 years) storage in the desiccated state. Upon rehydration, Fe-containing superoxide dismutase (Fe-SOD) was released and the activity was distributed between rehydrating cells and the extracellular fluid. The 21-kDa Fe-SOD polypeptide was purified, the N-terminus was sequenced, and the data were used to isolate *sodF* from the clonal isolate *N. commune* DRH1. s*odF* mRNA was abundant and stable in cells after long-term desiccation. Upon rehydration of desiccated cells, there was a turnover of *sodF* mRNA within 15 min and then a rise in the mRNA pool to control levels over 24 h. The extensive extracellular polysaccharide of *N. commune* DRH1 generated superoxide radicals upon exposure to UV-A or –B irradiation, and these were scavenged by SOD.

SURVIVABILITY RATES OF THE SOCIAL SPIDER *(ANELOSIMUS EXIMIUS)* IN NORTHERN/COASTAL FRENCH GUIANA, WHEN EXTRACTED IN LIMITED QUANTITIES FROM THEIR NATIVE COLONIES. Christopher D. Fowler, New Century College of George Mason University, Fairfax, VA 22030. Research and experiments conducted in August 1999 examined the survivability rates of the social spider, *Anelosimus eximius*. With some colony sizes that reach the upper-thousands, *A. eximius*, a border-colonizing species, exhibits social tendencies in hunting and capture of their prey and the maintenance of the web colony. This study examined the ability of individual animals to survive when put into habitat in limited quantities. A total of one hundred sixty-two colonies were placed into habitat, split between the edge of the rain forest and three to five meters inside the tree line. These new colonies were populated by a uniform number of animals. Each cup contained one of the following quantities: 15, 10, 5, 2, and 1. It was discovered in our research that those colonies containing smaller amounts of animals perished at a quicker rate than that of their more numerous peer colonies.

GROUP DECISION MAKING IN THE SOCIAL SPIDER *ANELOSIMUS EXIMIUS*. Stacey J. Rathbun & Robert Furey, New Century College of George Mason University, Fairfax, VA 22030. Over a period of 17 days, collective behavior, the conduct whereby individuals will act as a group, was studied using the social spider species *Anelosimus eximius* in edge habitat in French Guiana. Spiders were gathered, counted, and released into controlled vegetation. Plants shaped in the form of a "Y" were used so that the spider's choices were limited to two similar branches. Fifteen of these Y-shaped plants were manipulated to ensure that each side of the vegetation was equivalent to the other. We used 100 spiders from separate colonies for each arrangement and they were split into groups of 70 and 30. Each Y-setup contained 2 cups, one containing 70 spiders and the other 30 spiders. This system was created to observe the collective behavior of the spiders by reducing choice in the experimental setups by giving the spiders only 2 areas for web foundation. It helps us to observe group decision-making. During the course of the field study the spiders did not group in one complete cluster, but stayed on their respective sides instead of locating on one side. The spiders grouped together on the separate sections of the plants. The collective behavior was found to exist within the smaller groups as the spiders shifted to either side of the vegetation. Once the spiders moved up into branches of the Y-setups, they formed small groups underneath the leaves.

COLLECTIVE BEHAVIOR IN THE SOCIAL SPIDER *ANELOSIMUS EXIMIUS*. Ritu Maghera & Rob Furey, New Century College of George Mason University, Fairfax, VA 22030. Collective behavior is one of the most interesting characteristics exhibited by the social organisms. As one of the 16,000 known social spider species, *Anelosimus eximius* habitually form communal web colonies. Our experiment consisted of artificial colonies set up on the edges of the French Guanines rainforest outside Cayenne. Social interaction among *A. eximius* was examined by systematically increasing the population of particular colonies and observing colony reaction. The objective of this experiment was to determine what would happen to the colony once colony population balance was disturbed. In order to observe such changes, data for population, volume, and volume per individual were collected. We augmented populations over the 10 experiment days. There was a steady increase among the experimental groups in spider population, which directly effected the volume, volume per individual, and surface areas.

Biomedical and General Engineering

COMPUTATIONAL ANALYSIS OF HUMAN THERMAL COMFORT IN A VENTILATED ROOM. A.F. Alfahaid, S.K. Chaturvedi & S.N. Tiwari, Department of Mechanical Engineering, Old Dominion University, Norfolk, VA 23529. As the majority of people nowadays spend up to 90% of their time indoors, knowledge and prediction of the indoor climate conditions are an important component influencing our overall level of health and comfort. The present study pertains to the three dimensional numerical study and characterization of thermal environment in a ventilated room. The ultimate aim of this research is to study the effect of the room ventilation on human thermal comfort, which will enable better design for ventilated rooms. Unstructured grid has been used to model the three-dimensional ventilated room. Low-Reynolds-numbers k- turbulence model is employed in computational fluid dynamic simulations. Two kinds of boundary conditions, namely, constant temperature and constant heat flux, are applied to solve the governing equations for mass, momentum and energy transport. Percentage of dissatisfaction (PD) and effective draft temperature (EDT) are used as human thermal comfort indices to show the thermal comfort in three standard levels (ankle, sitting and standing).

RAPID MEASUREMENT OF *IN VIVO* AORTIC WAVE VELOCITY USING MAGNETIC RESONANCE. V.V. Itskovich[1], K.A. Kraft[2] & D.Y. Fei[1], [1]Departments of Biomedical Engineering and [2]Radiology, Virginia Commonwealth University, Richmond, VA, 23298. In this study, a new, rapid (120 ms acquisition time) method for obtaining the wave velocity (WV) in the human descending aorta using magnetic resonance (MR) was developed and validated in a compliant tube model. The general strategy this technique uses is to reproduce the fluid flow waveform at two separate locations along the compliant vessel. Because of the finite rate of propagation, the waveform arrives at the downstream location slightly later as compared to the upstream location. The known distance between the two measurement sites divided by this latency yields the wave velocity. Ten healthy subjects participated in the study. Age ranged from 22 to 57 years. WV ranged from 3.8 to 9.2 m/s; peak blood velocity (PBV) ranged from 56 to 113 cm/s. WV demonstrated positive correlation with age, while PBV exhibited strong negative correlation with age. Typical reproducibility values for the WV and PBV measurements for a given subject were 13% and 7%, respectively. Accurate WV assessment may be a useful predictor of potential damage in the human circulatory system.

LONG-TERM SURVIVAL OF REGENERATED CARTILAGE IN A NOVEL MODEL. J.S. Wayne, Orthopaedic Research Laboratory, Depts. of Biomedical Engineering and Orthopaedic Surgery, VCU & C.L. McDowell, Richmond VA Medical Center. Damage to articular surfaces in diarthrodial joints is a major cause of disability in our society. No technique has yet successfully regenerated a functional cartilage over a large joint surface. Our repair model regenerated a durable cartilage on a large joint surface by providing initial stress shielding from the harsh mechanical environment of the joint. In the long-term evaluation of the model, 15 canines underwent bilateral surgery in which the patellae were denuded of all articular cartilage, and small high density polyethylene joint spacers were placed on the patellar surfaces to lift them off the patellofemoral groove, thus providing stress-shielding. After cartilage regenerated on the patellae for 12 weeks, the spacers were removed to reintroduce the joint stress environment and stimulate further maturation. At one year, the regenerated cartilage continued to cover 75-100% of the entire patellar surface, the biomechanical properties (stiffness, permeability) indicated a tissue that was maturing, and the biochemical analyses (water, collagen, and proteoglycan contents) indicated the tissue was maintaining its characteristics at the one year time point. Financial support provided by RR&D of the Department of Veterans Affairs, #AR-799C.

AN INEXPENSIVE WEAR TESTING DEVICE FOR THE EVALUATION OF TOTAL JOINT REPLACEMENT MATERIALS. M. Thompson[1] & J.R. Foy[2], Depts. of [1]Mechanical Engineering and [2]Engineering Science & Mechanics, Virginia Tech, Blacksburg, VA 24061. In attempts to predict the *in vivo* performance of orthopaedic biomaterials, numerous wear apparatus and simulators have been developed to assess *in vitro* tribological performance. The most complex and expensive machines are simulators, which test actual prostheses in scenarios with kinematics mimicking the joint of interest. This project is focused on the design of a wear apparatus that is more economical for simulating the performance of materials for total knee replacement (TKR). Specifically, our design incorporates the most significant knee kinematics: flexion/extension (F/E), anterior/posterior (AP) sliding, tibial rotation (TR), and a dynamically-applied joint reaction force synchronized to a physiologically representative F/E motion. F/E, AP sliding, and TR are controlled by programmable motors interfaced to a data acquisition system. Flexibility of the designed apparatus allows for the independent control of each degree of freedom and up to four-station, simultaneous testing. Characterization of wear rates and mechanisms are to be compared with results from the literature to determine the feasibility of using the designed apparatus as a materials screening device for TKR. Financial support provided by the OSER/Carilion Health Initiative.

THE KINEMATICS OF FIELD HOCKEY DRIVING MOTIONS. S.M. Gerke & L.A. Wojcik, Department of Engineering Science & Mechanics, Virginia Tech, Blacksburg, VA 24061. Field hockey is an ancient sport that dates back to the ancient Greek, Roman, and Aztec civilizations. Current North American versions of the sport are primarily played by women at the high school and college levels. Driving motions with a field hockey stick are used to quickly advance a ball down the field, with the left hand providing much of the force in a downward pendulum motion. In an effort to determine optimal body configurations for completion of long drives, both expert (E) and novice (N) players were tested to determine backswing and followthrough heights, swing timing, and stick velocity. Ten young women between the ages of 18 and 30 were tested, with equal distribution between the E and N groups. Each subject completed five standing drives, with infrared-emitting diodes placed over bony landmarks on the body and on the stick for kinematic data collection. Significant experience-related differences were found in the backswing height (E>N, $p<0.01$) and followthrough velocity (E>N, $p<0.01$). Similar trends were observed in followthrough height and downswing velocity, though without statistical significance. Further analysis will include comparisons of stick velocity at ball contact, percentage of body weight shifted to the backswing foot, and learning effects in the novice subjects.

SPARSE ASSEMBLING PROCEDURES FOR STRUCTURAL ACOUSTICS FINITE ELEMENT ANALYSIS. W.R. Watson[1], V.N. Vatsa[1], Y Hu[2] & D.T. Nguyen[2], [1]NASA Langley Research Center, Hampton, VA 23681, [2]Department of Civil and Environmental Engineering, Old Dominion University, Norfolk, VA 23529. Different sparse algorithms for assembling of global matrices in finite element procedures are developed, tested and discussed. Structural/Acoustics examples are used to evaluate the performance (using SUN workstations) of various sparse assembling strategies. Preliminary results have indicated that the "sophisticated" sparse algorithm is substantially faster than the "simple" one.

COMPLEX SPARSE LANCZOS EIGEN-SOLVERS FOR ELECTRO-MAGNETICS ENGINEERING SOLUTIONS. C. Bunting[1], T.X. Nguyen[2], B. Han[1], Y. Hu[1] & D.T. Nguyen[1], [1]Department of Civil and Environmental Engineering, Old Dominion University, Norfolk, VA 23529, [2]NASA Langley Research Center, Hampton, VA 23681. Lanczos algorithms for solving medium to large-scale generalized eigenvalue engineering problems are developed, tested and discussed. Heavy computational tasks within Lanczos algorithms are identified. Sparse technologies are exploited to take full advantages of computer memory and computational time for solving medium to large-scale eigenvalue problems occurred in engineering applications. Both real and complex numbers appeared in the generalized eigen-equations can be treated.

HEALTH MONITORING OF A FRP BRIDGE DECK. M. Miceli[1] & J.C. Duke[2], Depts. of [1]Materials Science and Engineering & [2]Engineering Science and Mechanics, Virginia Tech, Blacksburg, VA 24061. Statistics released in the fall 1989 show that 238,357 (41%) of the nation's 577,710 bridges are either structurally deficient or functionally obsolete. New materials, less affected by corrosive environmental conditions than conventional civil engineering materials, are being suggested for use in bridge systems to solve this problem. As engineers look to these new materials to bear the load of this problem, they must incorporate ways to construct *and* inspect the bridge more easily. Composite deck systems (e.g., glass fiber reinforced vinyl ester matrix) are favorable replacements for deteriorating conventional bridge decks due to their durability and decreased weight, which can help avoid load posting of a bridge. This paper discusses the use of Infrared Thermography as a means of detecting delaminations and voids caused by conditions encountered in fabrication and the field. As forced convection hot air is applied to the bridge deck, delaminations in the top of the deck appear cold while problems in the bottom of the deck give rise to areas of hotter concentrations. The discontinuities in thermal propagation patterns are seen by the camera and indicate possible structural deficiencies. Laboratory results revealing fabrication problems and those from *in situ* tests will be presented.

POLYMER MICRO ENGINEERING FOR CHEMICAL SENSING APPLICATION. N.V. Levit & G.C. Tepper, Department of Chemical Engineering, Virginia Commonwealth University, Richmond, VA 23284. Polymers, due to their variety of properties and amenability to chemical modification, are one of the most promising materials for sensor applications. However, the methods employed to produce polymer surfaces are crude in comparison to the microelectronics-driven technology employed to produce miniature transducers. Rapid Expansion of Supercritical Solutions (RESS) is a technique that takes advantage of the enormous solubility change that occurs in a rapidly expanding supercritical solution in order to form precipitates with narrow and tunable size distributions. Silicone polymers are attractive for chemical sensor applications because of their favorable physical and chemical properties. The main disadvantage of raw siloxanes in sensor applications is the loss of surface integrity over time due to inadequate viscosity. Micro and nano particles of siloxane-based polymers were deposited onto the sensing surface of a Surface Acoustic Wave (SAW) transducer using the RESS technique. The mechanical properties of the particles were subsequently improved by crosslinking. The resulting sensor was calibrated and exhibits fast, reversible response to organic vapor.

TEMPERATURE DEPENDENCE OF ZERO-SHEAR VISCOSITY FOR POLYPHENYLENE OXIDE BY SQUEEZE-PLATE RHEOMETRY. M.J. Miraglia & K.E. Van Ness, Department of Physics and Engineering, Washington and Lee University, Lexington, VA 24450. This work is part of an ongoing project to measure the compositional dependence of the zero-shear viscosity at a fixed temperature for miscible polyphenyleneoxide (PPO)/polystyrene (PS) blends. Previous studies of these blends have been unable to measure directly this dependence for compositions of greater than 50 wt% PPO due to the interaction of two factors: (1) the high viscosity of the PPO relative to the PS at any given temperature, and (2) the tendency of the PS component to degrade at temperatures high enough to adequately soften the PPO component. Previous methods of measurement have used the cone-and-plate-geometry. Here we use a parallel plate geometry, the method of which is known as squeeze-plate rheometry, where the polymer melt is squeezed between two parallel plates, and the viscosity is calculated from the known squeezing force and the rate at which the gap between the plates narrows. The zero-shear viscosity for PPO can be measured at temperatures low enough to avoid PS degradation, thereby allowing for the measurement of the compositional dependence of viscosity for these blends. This study was funded in large part by the Thomas F. and Kate Miller Jeffress Memorial Trust.

A TWO-DIMENSIONAL WATER QUALITY TRANSPORT MODEL FOR GRADUALLY VARIED, UNSTEADY FLOW IN OPEN CHANNELS. L.A. Gatling, A.O. Kardash & J. Yoon, Department of Civil and Environmental Engineering, Old Dominion University, Norfolk, VA 23529. A steady-state source sink SWMM/QUAL2E water quality model framework of Pea Hill Arm of Lake Gaston was used to characterize in-lake flow and pollutant transport under conditions of pipeline water intake. To further characterize pollutant transport in the study site, time-variant longitudinal kinematic wave flow was conceptualized using two-dimensional Saint Venant continuity and momentum equations between the differential gradient upper- and lower- segment boundaries that contain the pipeline water intake section. Equations are formulated using an explicit two-dimensional schema based on a two-plane Prissiman box square method to include vertical benthic uplift diffusion as well as advective and dispersive physical transport into the water column. The two-dimensional approach is intended to handle step inputs to continuously model mass flow and pollutant transport, spatiotemporally, by including vertical flow and pollutant transport originating from the channel bed during very low longitudinal flow conditions including the velocity null.

AN INVESTIGATION OF CARRIER LIFETIMES AND DEEP TRAPS IN WIDE BANDGAP COMPOUND SEMICONDUCTORS. R.F. Kessick & G.C. Tepper, Department of Chemical Engineering, Virginia Commonwealth University, Richmond, VA 23284. The electrical and optical performance of wide bandgap compound semiconductors such as mercuric iodide (HgI_2) and cadmium zinc telluride (CdZnTe) depends strongly on the lifetimes of the charge carriers. Carrier lifetimes are influenced by various trapping mechanisms, which can take the form of crystal defects and impurities. Trap energies have been studied in these materials using techniques such as thermally stimulated current (TSC) or thermoelectric emission spectroscopy (TEES). However, the effect of specific traps on the carrier lifetimes remains unknown. Here we report on our investigations of the effect of charge traps on carrier lifetimes using a contactless, pulsed laser microwave cavity perturbation technique. The semiconductor microwave absorption coefficient is measured during pulsed laser excitation using a critically coupled resonating cavity. Carrier lifetimes are determined as a function of temperature and transition temperatures are related to trap energies.

OBJECT-ORIENTED DATABASES, TOWARDS AN INTEGRATED ENGINEERING-COMPUTATION ENVIRONMENT. H.M. AbdelSalam & H.P. Bao, Department of Mechanical Engineering, Old Dominion University, Norfolk, VA 23529. The rapid developments in information technology and information systems are changing the methods and media by which people communicate and interact. How these emerging new technologies affect the engineering work is still a question. Usually in the development process of a new product/process, several teams of engineers with different backgrounds/responsibilities are involved. Engineers need a tool(s) to share technical and managerial information and to be able to instantly access the latest changes made by one member, or more, in the teams to determine right away the impacts of these changes in all disciplines (cost, time, resources, etc.). In other words, engineers need to participate in a truly collaborative environment for the achievement of a common objective, which is the completion of the design project in a timely, cost effective, and optimal manner. In this paper, a new framework that integrates the capabilities of two commercial software, MS Excel™ and MS Project™ with a state-of-the-art object-oriented database (knowledge-base) called InnerCircle2000™ is being presented and applied to handle the Time-Cost Trade-Off problem in project networks.

AN EMPIRICAL EVALUATION OF COMPUTER-MEDIATED COMMUNICATION TECHNOLOGIES TO SUPPORT TUTORING. P.E. Smith, B.M. Kleiner & B.A. Watford, Dept. of Industrial and Systems Engineering, Virginia Tech, Blacksburg, VA 24061. With the rapid introduction and integration of technology into everyday living, new opportunities arise to facilitate student support within higher education. Tutoring is one example of a process that may be improved. The purpose of this research was to investigate computer-mediated communication technologies used during tutoring to determine if these technologies can improve tutoring assistance and to research several different communication platforms that may be amenable to tutoring assistance. The communication conditions consisted of collocated communication, email, a chatroom, and video teleconferencing. The research design was a 2x4x4 within subject's factorial design and sixty-four laboratory trials were conducted. Data related to problem solving accuracy, speed, and user satisfaction were collected to determine communication media effectiveness. In general, problem-solving accuracy was similar in all experimental conditions, while communication media affected problem-solving speed and user satisfaction. These results suggest computer-mediated tutoring was as effective as collocated tutoring based on accuracy, while collocated and chatroom tutoring were similar based on speed and user satisfaction.

INITIAL EXPERIENCE WITH PARALLEL ENGINEERING COMPUTATION UNDER MPI/FORTRAN AND LINUX PCS COMPUTER. S. Hans[1], S.Y. Bawab[1], A. Demuren[1] & D.T. Nguyen[2], Departments of [1]MEM and [2]Civil and Environmental Engineering, Old Dominion University, Norfolk, VA 23529. Clusters of PC desktops and/or laptops are connected for general (educational & research) parallel computation, using freely available parallel MPI/FORTRAN and LINUX operating systems. Small scale, simple examples are used to explain and demonstrate the details of the step-by-step procedures.

DECOMPOSITION PROCEDURES FOR LINEAR PROGRAMMING PROBLEMS: SEQUENTIAL COMPUTER ENVIRONMENTS. Y. Hu, K. Gould, & D.T. Nguyen, Department of Civil and Environmental Engineering, Old Dominion University, Norfolk, VA 23529. Dantzig's decomposition procedures are re-examined from the viewpoint of exploiting sparse and parallel technologies. The general idea of breaking up a large-scale problem into series of small-scale problems is first briefly reviewed. Then, computational tasks which can be parallelized and enhanced by sparse algorithms are identified and discussed. Simple numerical examples are used to explain how to prepare the input data for the developed computer codes.

Botany

ICE DAMAGE TO TREES ON THE VIRGINIA TECH CAMPUS. R. W. Rhoades and R. J. Stipes, Dept. of Plant Pathology., Physiology, and Weed Science, Virginia Tech, Blackburg, VA 24061. A survey of 200 trees representing 9 spp. was made in 1995 after 3 ice storms in 1994 each deposited 2.5 cm or more of ice on trees. Amount of ice damage was expressed as % crown damage. Overall crown damage was 8.6%, but 22.8% of individuals and 22.1% of basal areas were damaged. Most severely damaged, rated by % crown damage, were black maple (*Acer nigrum*)=16.0, American elm (*Ulmus americana*)=15.4, sycamore (*Platanus occidentalis*)=15, sugar maple (*Acer saccharum*)=12.8, Alaska white cedar (*Chamaecyparis pisifera*)=11.7, and white oak (*Quercus alba*)=10.0. Lightly damaged were flowering dogwood (*Cornus florida*)=3.8 and northern red oak (*Quercus rubra*)=1.0. Pin oak (*Quercus palustris*) was undamaged. Severe damage resulted in removal of 19 trees, including 5 American elms that had died of Dutch elm disease. A one-way analysis of variance showed that differences among species were not significant. Apparently the severe ice storm on February 13, 1994 did indiscriminate damage, thereby erasing differences among species.

POST-DISTURBANCE CHANGES IN THE UNDERSTORY OF AN OAK FOREST IN SOUTHWEST VIRGINIA. R. W. Rhoades, Department of Plant Pathology, Physiology, and Weed Science, Virginia Tech, Blacksburg, VA 24061. An Appalachian oak forest, previously dominated by scarlet and chestnut oaks, was sampled in 1994, and was re-sampled in 1999 to determine changes in composition of understory vegetation and height growth of established seedlings and saplings after disturbance by single tree gaps, primarily scarlet oak, and general canopy ice damage. Changes in overstory tree density and basal area were not significant, indicating that the stand is in a steady state phase of development. Post-disturbance increases in densities of shrubs, saplings, and red maple seedlings, plus decline in density of flowering dogwood seedlings were significant. Increase in height growth of white pine was also significant. By inference, the stand should be dominated in about 20 years by overstory trees of chestnut oak, red maple and white pine. Natural thinning of white pine saplings may negate the prediction that this species will become codominant.

EFFECTS OF SPATIAL NUTRIENT HETEROGENEITY ON COMPETITIVE OUTCOMES IN FOUR EARLY SUCCESSIONAL PLANT SPECIES. K. M. Bliss,.[1], R. H. Jones[1], P. P. Mou[2], & R. J. Mitchell[3], [1]Dept of Biology, VPI & SU, Blacksburg, VA 24060, [2]Dept of Forestry, VPI & SU, Blacksburg, VA 24060, Jones Ecological Research Center[3], Newton, GA 31770. We hypothesize that small scale spatial heterogeneity of soil nutrients can impact competitive outcomes and succession. We established monocultures and mixtures of 2 and 4 plant species in garden plots with homogeneous or heterogeneous spatial patterns of soil nutrients. Monocultures showed that three species exhibit foraging precision: *Erechtites hieracifolia* (Eh), *Pinus taeda* (Pt), and *Liquidambar styraciflua* (Ls) ($p<.01$). After one growing season, heterogeneity enhanced aboveground biomass of Eh ($p<.01$) and reduced growth of *Solidago altissima* (Sa) ($p<.001$) in 2 species plots. Ls (grown with Pt) had larger biomass in the heterogeneous treatment (p, ns). So, heterogeneity of resources may confer an aboveground competitive advantage for precise foragers. In the four species plots, heterogeneity of nutrients enhanced performance of three species (Eh, Ls, and Pt) and hampered growth of one species (Sa), further indicating that nutrient heterogeneity may have significant effects on interspecific competitive outcomes in larger plant communities.

A COMPARISON OF NUTRIENT AVAILABILITY AND PHYTOPLANKTON GROWTH IN TWO PONDS LOCATED WITHIN COMMERCIAL DEVELOPMENTS. Stephen W. Fuller, Kelly A Donovan, & Lori M. Walsh, Dept. of Biol., Mary Washington College, Fredericksburg, Va. 22401. Water samples were collected from two ponds located in different commercial complexes in Fredericksburg, Va. Approximately biweekly collections from early February to later April were examined for phytoplankton and tested for the nutrients silicon, nitrate and orthophosphate. The ponds were similar in nutrient content, radiation input, and temperature; however there were consistently more waterfowl present in the smaller pond. In contrast to what was expected, the smaller, younger pond had a larger phytoplankton population, and greater diversity of species. Also unexpected, and differing from the PEG model, was the paucity of diatom species and numbers in both locations. A spring outburst occurred, but was produced by an increase in the number of species in Division Chlorophyta.

RELATIONSHIPS OF CHONOCENTRUM (EUPHORBIACEAE). W. John Hayden & Sheila M. Hayden, Dept. of Biology, Univ. of Richmond, Richmond, VA, 23173. *Chonocentrum* is a poorly understood euphorbiaceous tree known only from the type collection gathered in 1854 from an island in the Rio Negro, Brazil, near its confluence with Rio Marauia. Initially, *Chonocentrum* was confused with *Discocarpus*, it was later named as a species of *Drypetes*, then named as a distinct genus, but is still assumed to be related to *Discocarpus.* The minute staminate flowers of *Chonocentrum* possess a single whorl of fused sepals, an extrastaminal disk, separate stamens, and a prominent pistillode bearing a distinctive funneliform stigmatic region; further the staminate flowers produce distinctly prolate grains, according to Punt. Features of staminate flowers, therefore, argue against classification near *Discocarpus* in tribe Wielandieae. The prolate pollen suggests placement in tribe Antidesmeae, a classification confirmed by cladistic analyses of the available morphological characters. In most analyses *Chonocentrum* occupies a sister-taxon relationship to subtribe Antidesminae, a group defined by a series of distinctive anther features not found in *Chonocentrum*.

STUDENT PROJECTS IN PLANT ANATOMY: A THEMATIC APPROACH WITH A FOCUS ON CASSAVA. W. John Hayden, Biol. Dept, Univ. of Richmond, Richmond, VA, 23173. The use of thematic projects focusing on a single plant, cassava (*Manihot esculenta*), in an undergraduate course in plant anatomy is described. Projects included: 1) library research on the biology and utility of cassava and production of stem cross sections via simple microtomy, to introduce students to the plant and to review fundamentals of plant morphology and anatomy; 2) maceration of xylem for comparison with a conifer, emphasizing differences in cell composition of water conducting tissue, differences in tracheids and vessel element lengths, and evidence for apical intrusive growth in dicot fibers; 3) leaf clearings for leaf architectural analysis; and 4) a combined LM and SEM study of foliar epidermis. Student-generated images were digitized and posted on a web page for use in lab reports. Both epidermal layers of *Manihot* are uniseriate, bear scattered druse idioblasts and unicellular hairs; intercostal regions of the abaxial surface are further characterized by brachyparacytic stomata and protruding cells that are organized into reticular patterns that surround one or two stomatal complexes. Melding of traditional content with hands-on projects and web distribution of anatomical images appears to be a successful format to teach plant anatomy emphasizing how research in plant structure is performed.

COEVOLUTIONARY IMPLICATIONS OF INTROGRESSION BETWEEN *RHODODENDRON ATLANTICUM* (ASHE) REHDER AND *R. PERICLYMENOIDES* (MICHAUX) SHINNERS. Bruce L. King, Dept. of Biol., Randolph-Macon College, Ashland, Va. 23005. Natural hybridization between *Rhododendron atlanticum* and *R. periclymenoides* was documented using a mixture of morphological and micromolecular characters. Herbivory by *Pyrrhalta rufosanguinea*, a leaf beetle monophagous for *R. periclymenoides*, was estimated by cafeteria style host-choice experiments. Statistical analyses indicated bidirectional introgression in the hybrid population. The results of feeding experiments suggested that a combination of stimulants and inhibitors affect feeding responses by the beetles. Some leaf variables may be more important for discrimination between *Rhododendron* species and discrimination among hybrids, while others may be more important for selection of the most palatable plants in populations of *R. periclymenoides*. Two hypotheses regarding the evolutionary significance of introgression are proposed: 1) introgression from *R. atlanticum* to *R. periclymenoides* may result in greater resistance of *R. periclymenoides to the* leaf beetle; 2) gene flow from *R. periclymenoides* to *R. atlanticum* may allow *P. rufosanguinea* to become adapted to *R. atlanticum*.

A DENDROECOLOGICAL STUDY OF THREE RED SPRUCE (*PICEA RUBENS*) POPULATIONS. David M. Lawrence[1], Harold S. Adams[2] & Steven L. Stephenson[3]. [1]Virginia Department of Environmental Quality, 629 E. Main Street, Richmond, VA 23219. [2]Division of Arts and Science, Dabney S. Lancaster Community College, Clifton Forge, VA 24422 and [3]Dept. of Biology, Fairmont State College, Fairmont, WV 26554. A dendroecological investigation was undertaken of three red spruce (*Picea rubens*) populations in the vicinity of Mountain Lake, Virginia. Tree-ring chronologies were developed from samples collected at War Spur, Mann's Bog and Little Spruce Bog. The War Spur population was the oldest, with trees dating to the 1730s, followed by Mann's Bog (1760s) and Little Spruce Bog (1860s). Response-function analyses revealed that growth in all three populations was limited by high temperatures in the previous growing season. War Spur growth was negatively correlated with temperature in the previous August and positively correlated with prior July and current March precipitation. Growth at Mann's Bog was negatively correlated with temperatures in the prior October and current August as well as with current February precipitation. Tree growth at Little Spruce Bog was negatively correlated with prior June and September temperature and positively correlated with temperature in the current April.

GEOGRAPHY OF MONTANE FORESTS IN VIRGINIA. David M. Lawrence[1], Steven L. Stephenson[2], Harold S. Adams[3] & Stewart Ware[4]. [1]Virginia Department of Environmental Quality, 629 E. Main Street, Richmond, VA 23219, [2]Department of Biology, Fairmont State College, Fairmont, WV 26554, [3]Division of Arts and Sciences, Dabney S. Lancaster Community College, Clifton Forge, VA 24422 and [4]Department of Biology, College of William and Mary, Williamsburg, VA 23187. Geographic patterns in forest community composition in the mountains of Virginia were evaluated using overstory data from more than 350 stands sampled by the authors and others during the past 30 years. Three major groups of forest communities are revealed: spruce-fir; mixed mesophytic, and oak-pine. Both indirect and direct gradient analyses supported identification of these groups by segregation of forest types within each group in more or less distinct regions of ordination space. Gradients in community composition were compared to gradients in regional factors (latitude, longitude), local factors (elevation, aspect, slope steepness, slope position, and site moisture), and temporal factors (stand basal area and density, as these two parameters reflect successional status). Both correlation and direct gradient analyses revealed that elevation, basal area, longitude, latitude and density had the strongest relationships with gradients in overstory composition.

DEFINING SPECIES, OR THE RANGE OF ECOLOGICALLY INDUCED VARIABILITY IN PHYTOPLANKTON MORPHOLOGY. Harold G. Marshall[1] and Lubomira Burchardt[2], [1]Dept. Biol. Sci., Old Dominion Univ., Norfolk, Va.; [2]Dept. Hydrobiology, Adam Mickiewicz Univ., Poznan, Poland. Many phytoplankton species have considerable variation in morphological traits used in their identification. These differences may be initiated by environmental cues that result in an altered appearance of one or more of these taxonomic features and can result in confusion regarding species identification. Little attention is generally given to other life stages of species (e.g. dinoflagellates) that may also be used in their identification, or conditions that would modify the morphology of these stages (e.g. salinity, temperature, nutrients, pH, etc.). These environmentally induced morphological variations may also become more widely characteristic of a species, requiring a re-evaluation of that species characteristics and status. The phytoplankton analyst must be aware of the range of variations normally occurring within this community, and be familiar with seasonal morphological changes, or life cycle stages associated with members of the phytoplankton to more accurately identify many of these species. Gene sequencing will be necessary to more accurately describe the morphological variations exhibited by many phytoplankton species, and in the revision of other presently accepted taxa.

COMMERCIAL SHOPPING AREA POND WITH A RESIDENTIAL AREA POND. Heather McEachen, Lara M. Isdell, & Stephen W. Fuller, Dept. of Biol., Mary Washington College, Fredericksburg, Va. 22401. Phytoplankton succession was observed over a nine-week period in ponds from two different environs, one residential, and the other commercial. Nutrient analysis was performed on water samples for nitrate, orthophosphate, and silicon. Samples of phytoplankton were identified, preserved, and then counted on Sedgwick-Rafter cells (Woelkerling, 1976). Species from Divisions Chlorophyta and Chrysophyta were found in each pond. The commercial pond was found to have larger phytoplankton populations than the residential pond, which correlates with the presence of waterfowl there and their absence in the residential area. No difference in nutrient content in the two ponds was identified.

PHYTOPLANKTON COMMUNITY STRUCTURE IN LAKE PRINCE, SUFFOLK, VA. A PRELIMINARY REPORT. Cara M. Muscio, Old Dominion University Department of Biology. Lake Prince is a reservoir lake that provides the region with drinking water, recreational boating, and fishing. The Virginia Department of Game and Inland Fisheries has an interest in the quantity and quality of phytoplankton production in the lake, especially regarding the health of fish populations. Another concern in this reservoir is oxygen availability, and aerators have been installed in the main body of the lake. A year long examination of the phytoplankton community structure is being conducted. Duplicate surface water samples are collected monthly from three stations, along with physical and chemical baseline data. Community structure and dominance are being examined with regard to the physical and chemical parameters, as well as seasonal climate changes. Spring populations were dominated by Cryptophytes, which gave rise to high concentrations of Cyanobacteria through the summer months. Diatoms and Chlorophytes are secondary components of the phytoplankton community.

COMPARISION OF FIELD COLLECTION TECHNIQUES FOR IN VITRO CULTURES. Michael H. Renfroe & and Julie F. O'Hara, Department of Biology, James Madison University, Harrisonburg, VA 22807. Germplasm conservation efforts may be augmented by plant tissue culture. Establishment of axenic cultures from field-collected materials depends upon elimination of the bacterial and fungal population on the explant surface, and maintaining the health of the explant prior to placement on a culture medium. Explants were collected from woody and herbaceous species, treated for microbial reduction and planted or stored for three days to simulate shipping prior to planting on culture medium. Best results for woody plant species (*Betula pendula*, *Corylus avellana*)were obtained by treating with ethanol, storing in an anti-microbial solution, and treating with hypochlorite prior to planting. Best results for the herbaceous species (*Portulaca oleracea*) were obtained with direct transport and sterilization in the laboratory. Direct planting in the field produced most contamination, even with anti-microbial agents in the medium. For field collection and delayed planting, a treatment in the field and laboratory with anti-microbial agents in the medium was most beneficial.

ICE DAMAGE TO TREES ON THE VIRGINIA TECH CAMPUS. R. W. Rhoades and R. J. Stipes, Dept. of Plant Pathology., Physiology, and Weed Science, Virginia Tech, Blacksburg, VA 24061. A survey of 200 trees representing 9 spp. was made in 1995 after 3 ice storms in 1994 each deposited 2.5 cm or more of ice on trees. Amount of ice damage was expressed as % crown damage. Overall crown damage was 8.6%, but 22.8% of individuals and 22.1% of basal areas were damaged. Most severely damaged, rated by % crown damage, were black maple (*Acer nigrum*)=16.0, American elm (*Ulmus americana*)=15.4, sycamore (*Platanus occidenetalis*)=15, sugar maple (Acer saccharum)=12.8, Alaska white cedar (*Chamaecypari pisifera*)=11.7, and white oak (*Quercus alba*)=10.0. Lightly damaged were flowering dogwood (*Cornus florida*)=3.8 and northern red oak (*Quercus rubra*)=1.0. Pin oak (*Quercus palustris*) was undamaged. Severe damage resulted in removal of 19 trees, including 5 American elms that had died of Dutch elm disease. A one-way analysis of variance showed that differences among species were not significant. Apparently the severe ice storm on February 13, 1994 did indiscriminate damage, thereby erasing differences among species.

POST-DISTURBANCE CHANGES IN THE UNDERSTORY OF AN OAK FOREST IN SOUTHWEST VIRGINIA. R. W. Rhoades, Department of Plant Pathology, Physiology, and Weed Science, Virginia Tech, Blacksburg, VA 24061. An Appalachian oak forest, previously dominated by scarlet and chestnut oaks, was sampled in 194, and was re-sampled in 1999 to determine changes in composition of understory vegetation and height growth of established seedlings and saplings after disturbance by single tree gaps, primarily scarlet oak, and general canopy ice damage. Changes in overstory tree density and basal area were not significant, indicating that the stand is in a steady state phase of development. Post-disturbance increases in densities of shrubs, saplings, and red maple seedlings, plus decline in density of flowering dogwood seedlings were significant. Increase in height growth of white pine was also significant. By inference, the stand should be dominated in about 20 years by overstory trees of chestnut oak, red maple and white pine. Natural thinning of white pine saplings may negate the prediction that this species will become codominant.

DROUGHT TOLERANCE OF CO-OCCURRING SPECIES OF OZARK ROCK OUTCROP *SEDUM*. Heather Sahli & Stewart Ware. Dept. of Bio, Col. of William and Mary, Williamsburg,VA 23186. In rock outcrop ecosystems soil depth increases with increased distance from the exposed rock surface. On sandstone glades, two small winter annual *Sedum* species co-exist. S*edum nuttallianum* dominates closest to exposed rock, with *S. pulchellum* dominating with increased soil depth. Since soil depth directly affects moisture, we hypothesized that *S. nuttallianum* is more drought tolerant than *S. pulchellum*. Plants in pots with equal amounts of soil were watered every 2 days (wet), every 10 days (intermediate), and every 3 weeks (dry). A second method was used in which pots contained soil depths of either 3, 2, or 1cm, and all pots were watered once a week. In both species there were significant differences between biomass in wet and dry, and between intermediate and dry treatments. In the second method, *S. nuttallianum* was significantly larger in all treatments and had a greater percentage of maximum biomass under intermediate and dry conditions than *S. pulchellum*. In all trials, *S. nuttallianum* exhibited a greater percentage of maximum flowering capability under intermediate and dry conditions than *S. pulchellum,* indicating *S. nuttallianum*'s superior ability to sustain populations in drought conditions.

ROOTING LONGLEAF PINE, PINUS PALUSTRIS MILLER, FROM NEEDLE FASCICLES. Phil Sheridan[1&2] , Kneeland Nesius[2], & Leslie Everett[2], [1]Meadowview Biological Research Station and [2]Department of Biological Sciences, Old Dominion University. Longleaf pine is a rare plant in Virginia with only 4432 trees remaining in the wild in the state. Cone crops can be erratic and seed yields per cone are less than the average reported for southern provenance. We were interested in determining the feasibility of regenerating rare Virginia longleaf pine from needle fascicles. If we can successfully regenerate native longleaf pine trees from needle fascicles than we can compensate for erratic seed production and, more importantly, capture the entire longleaf pine genome in Virginia for conservation purposes. Our initial efforts have focused on replicating other workers results with grass stage seedlings. Up to 65% of fascicles from a seedling can produce roots when placed in a 2 cm deep solution of 100 ppm IBA for 24 hours followed by maintenance in a solution of 60 ppm H3BO3, 40 ppm NH4NO3, and 20 ppm thiamine-HCl.

PHYLOGENETIC ANALYSIS OF ILIAMNA (MALVACEAE) USING THE INTERNAL TRANSCRIBED SPACER REGION. T. A. Bodo Slotta, D. M. Porter & B. S. J. Winkel, Dept. of Biol., VA Tech., Blacksburg, VA 24061. The eight species of *Iliamna* have a taxonomically complex history. Since its conception in 1906, the genus was not recognized for some time, several species have been placed into other genera, and the status of a few species has been questioned. The need for systematic study became apparent since all but one species is considered rare or endangered and the differentiation between two species, *I. corei* and *I. remota*, was unclear using RAPDs. The focus of this study was to develop a phylogeny for *Iliamna* using sequences from the internal transcribed spacer in hopes of determining evolutionary history of the genus. In this molecular analysis, *Iliamna* forms a well-supported clade distinct from related genera and is monophyletic. Three well-supported groups are formed. One contains representatives from the Pacific Northwest and forms the base of the genus. Another contains all of the remaining species with the third clade nested therein. The last clade contains the two eastern species, *I. corei* and *I. remota*. However, little resolution was brought about for *I. crandalii*, *I grandiflora*, *I. longisepala*, and *I. rivularis*. The ITS phylogeny brings new insight to the origination of and to the distribution of the genus.

PHYTOPLANKTON STATUS AND TRENDS IN THE LOWER CHESAPEAKE BAY. T. Stem, H. Marshall, M. Kokolis, C. Muscio, & B. Brown. Dept. Biological Sciences, Old Dominion University, Norfolk VA, 23529-0266. An update and review of findings from the Chesapeake Bay Phytoplankton Monitoring Program, from 1985 through 1998 is presented in addition to relative water quality. The overall status of the phytoplankton community is good for the Bay, being dominated by favorable populations (diatoms) that are active food and oxygen producers throughout the year. However, there are troublesome trends developing for increased populations of several less favorable cyanobacteria and dinoflagellates at scattered locations within the system. These trends are associated with degrading water quality conditions that include increased levels of total suspended solids and high nutrient levels. A trend of decreasing salinity in the Bay was accompanied by areas with increased concentrations of chlorophytes, cyanobacteria, and dinoflagellates. It is not certain if many of these trends represent short term responses to cyclic environmental events, or are of long term significance, that if continued, may lead to shifts in population composition. Potential toxin producing species are also being monitored with none of these associated with a toxic event in Virginia waters to date. Supported by the Virginia Dept. of Environmental Quality and EPA.

AN ECOLOGICAL STUDY OF THE SWEET BRIAR COLLEGE OLD-GROWTH WHITE OAK FOREST. Steven L. Stephenson[1], Harold S. Adams[2] & David M. Lawrence[3]. [1]Dept. of Biology, Fairmont State College, Fairmont, WV 26554, [2]Division of Arts and Science, Dabney S. Lancaster Community College, Clifton Forge, VA 24422 and [3]Virginia Department of Environmental Quality, 629 E. Main Street, Richmond, VA 23219. Quantitative data on the composition and structure of all strata of vegetation were collected from an old-growth white oak (*Quercus alba*) forest on the campus of Sweet Briar College in Amherst County, Virginia. In addition, increment growth cores were extracted from representative larger white oak trees for age determination. White oak, with an importance value (IV) of 32.8, was clearly the dominant species present in the tree stratum (stems >10 cm DBH), with tulip-tree (*Liriodendron tulipifera*), sourwood (*Oxydendrum arboreum*), and beech (*Fagus grandifolia*) the most important associates. White oak was conspicuously absent from the small tree (stems <10 but >2.5 cm DBH) and sapling (stems <2.5 cm DBH but >1.0 m tall) strata but had a higher importance value than any other species in the seedling stratum. The oldest cored trees dated back to the 1770s.

THE RELATIONSHIP BETWEEN ABOVE- AND BELOWGROUND STRUCTURE IN LONGLEAF PINE (*PINUS PALUSTRIS*) FORESTS. Glen N. Stevens[1], Robert H. Jones[1], & Robert J. Mitchell[2], [1]Department of Biology, VPI&SU, Blacksburg, VA, 24061 and [2]Joseph W. Jones Ecological Research Center, Newton, GA, 31770. Understanding the relationship between above- and belowground structure is critical in longleaf pine (*Pinus palustris*) forests, where small canopy gaps play a major role in forest regeneration. We assessed fine root production across a range of overstory densities in a longleaf pine stand in Southwest Georgia. Stands were harvested to a constant basal area using three spatial arrangements: single-tree selection, small-group (~0.1ha) selection, and large-group (~0.2ha) selection. Tree basal area within a 20m radius of each sample plot was positively correlated with pine root density ($p<0.0001$) and negatively correlated with non-pine root density ($p<0.05$). While harvest had no significant effect on treatment-level pine root mass, there was an increase in the number of ingrowth cores with zero pine root mass as gap size increased. In addition, there was a significant change in the depth distribution of fine roots between control and large-gap harvested plots (Kolmogrov-Smirnov test, $p<0.01$). Overall, belowground gaps in these systems occurred at much finer temporal and spatial scales than aboveground gaps.

VASCULAR FLORA OF THE WATERSHED OF WILLCOX BRANCH OF LIEUTENANT RUN, INCLUDING LEE PARK, PETERSBURG, VIRGINIA. PART I. Donna M. E. Ware, Dept. of Biol., Col. of William and Mary, Williamsburg, VA 23187-8795. A late 1930s W.P.A. project created a 10 ac. Wildflower Sanctuary in Lee Park (> 300 ac.) and the "Lee Park Herbarium". This W.P.A. program was administered by women for the purpose of aiding women heads-of-household in Petersburg during the Great Depression and addressing conservation concerns of the era. The herbarium collection consists of 325 pressed specimens (295 spp.) collected in or near this watershed by African-American women workers and identified by Donald Holden, the project supervisor, plus 238 botanical watercolors by Bessie Marshall. It includes 15 spp. now listed as rare in Virginia. My ongoing study has resulted in: 1.) annotation of Mrs. Holden's identifications of the species; 2.) updated scientific names; 3.) determination that ca. 70% of the species in the herbarium collection are present in the study area today, including 16 records for Dinwiddie Co.; 4.) determination that relatively few of the transplanted species have persisted in the Wildflower Sanctuary and that the 15 rare species are no longer present in the watershed; and 5.) collection of voucher specimens of ca. 600 spp. from the watershed. Phytogeographic analysis of the current local flora will be presented in Part II.

INTRODUCING SOUTHERN RED CEDAR (*JUNIPERUS VIRGINIANA* var. *SILICICOLA*) TO VIRGINIA BOTANISTS: ECOLOGICAL CONSIDERATIONS. Robert A. S. Wright, Parsons Transportation Group, Inc., Fairfax, Va. 22030. Recent floristic inventories in coastal fastlands have demonstrated the need to further investigate the apparently unreported occurrence of southern red cedar in seasonally-tidal forested wetlands on the outer Coastal Plain of Virginia. According to nearly all consulted literature sources, this taxon supposedly ranges only as far north along the Atlantic Coastal Plain province to Tyrell and Dare Counties, North Carolina. However, cedar trees occurring in small, nearly pure stands that better fit the ecological and morphological description of *Juniperus silicicola,* the southern coastal form of the more widespread eastern red cedar (*Juniperus virginiana),* have been documented at elevations below 10 feet MSL in numerous localities. Data will be presented to include the very localized southern red cedar as a component of the Virginia flora. Additionally, identification keys, taxonomy, life history, and ecological considerations are summarized and handout materials provided. Mounted herbarium and fresh specimens will be available for inspection.

Chemistry

THE SEARCH FOR PHYTOESTROGENS IN PEANUTS. Wendi Bousfield, Department of Chemistry, Hollins University, Roanoke, VA 24020 and Roy L. Williams, Department of Chemistry/Biochemistry, Old Dominion University, Norfolk, VA 23529. Phytoestrogens, estrogenic compounds found in plants, have become the focus of extensive research in recent years. This laboratory has been investigating the presence of such compounds in a variety of plant materials including soy, grape seeds and wine. This study has now been extended to include peanuts. Peanuts were analyzed for the presence of several isoflavonoids phytoestrogens including daidzein and genistein together with the unique stilbene phytoestrogen known as trans-resveratrol (TR). Although TR has been detected in peanuts earlier the isoflavonoid phytoestrogens have only been described in unpublished references. A method has been developed to detect both of these types of phytoestrogens using high-pressure liquid chromatography (HPLC). The results of this study have shown that raw peanuts contain a significant amount of genistein and TR. Peanut hulls showed some of the highest content of TR and genistein. Roasting the peanuts appears to destroy much of the phytoestrogens.

REDUCTION PRODUCTS OF PHYTOESTROGENS. Susan Foster Riggleman, Gabriel Rivera, Angela Rivera and Roy L. Williams. Department of Chemistry/Biochemistry, Old Dominion University, Norfolk, VA 23529. Phytoestrogens have recently attracted a great deal of attention due to their wide variety of reported biological activities and their potential as nutraceuticals. Isoflavonoid phytoestrogens such as daidzein and genistein are found in a wide variety of plant materials and undergo rapid metabolism *in vivo*. One of the major metabolic pathways is reduction of the isoflavonoid ring. This paper will describe the synthesis of 2,3- dihydrogenistein via catalytic transfer hydrogenation (CTH). The method of synthesis, a possible reaction mechanism and the spectral identification of this dihydro product will be described. This dihydrogenistein was further characterized by evaluating its potential to effect calcium influx in thrombin stimulated human platelets. While genistein has been shown to be effective and inhibits calcium entry in this model the dihydrogenistein was found to be considerably less active. The inhibition of calcium entry into human platelets has a direct impact on the development of cardiovascular disease and compounds that can are capable of calcium inhibition would be of interest pharmacologically.

REDUCTION PRODUCTS OF PHYTOESTROGENS. Susan Foster Riggleman, Gabriel Rivera, Angela Rivera, & Roy L. Williams. Department of Chemistry/Biochemistry, Old Dominion University, Norfolk, VA 23528. Phytoestrogens have recently attracted a great deal of attention due to their wide variety of reported biological activities and their potential as nutraceuticals. Isoflavonoid phytoestrogens such as daidzein and genistein are found in a host of different plant materials and undergo rapid metabolism *in vivo*. One of the major metabolic pathways is reduction of the isoflavonoid ring. This paper will describe the synthesis of 2,3-dihydrogenistein via catalytic transfer hydrogenation (CTH). The method of synthesis, a possible reaction mechanism and the spectral identification of this dihydro product will be described. This dihydrogenistein was further characterized by evaluating its potential to effect calcium influx in thrombin stimulated human platelets. While genistein has been shown to be effective and inhibits calcium entry in this model the newly synthesized dihydrogenistein was found to considerably less active. The inhibition of calcium entry into human platelets has a direct impact on the development of cardiovascular disease and compounds that are capable of calcium inhibition would be of interest pharmacologically. Structure activity studies of such compounds would help determine the mode of action of such drugs.

LUMINESCENCE OF LANTHANIDE(III) MACROCYCLIC COMPLEXES IN AQUEOUS SYSTEMS. S.A. Williams[1], R.C. Leif[2], J.R. Quagliano[3], and L.M. Vallarino[1], [1]Department of Chemistry, Virginia Commonwealth University, Richmond, VA 23284, [2]Newport Instruments, San Diego, CA , and [3]Los Alamos Research Laboratory, Los Alamos, NM. Luminescent macrocyclic complexes of europium(III) and samarium(III), which are water-compatible, can be covalently attached to target substrates, and have narrow emissions with long excited-state lifetimes, are finding use as bio-markers for both cytology and immunology. The emission intensity of these complexes can be greatly enhanced by the addition of non-luminescent energy-transfer agents, such as the gadolinium(III) and yttrium(III) ions, in a buffered micellar system containing a combination of synergistic ligands. Under these conditions, the Eu(III) $^5D_0$ $^7F_2$ emission of the Eu(III)-macrocycle was observed as a very sharp band with maximum at 619 nm and a characteristic fine-structure pattern. The Sm(III) emissions of the Sm(III)-macrocycle appeared at 599 nm ($^4G_{5/2}$ $^6H_{7/2}$) and 644, 652 nm ($^4G_{5/2}$ $^6H_{9/2}$) as sharp bands, easily distinguished from the Eu(III) emission. This method allows simultaneous determination of the two complexes in the same solution and at the same excitation wavelength (370 nm), with detection limits of 10^{-9} M for the Eu(III)-macrocycle and 10^{-7} M for the Sm(III)-macrocycle.

COMPUTER SIMULATED IR SPECTRA OF GADOLINIUM COMPLEXES USING GAMESS. Kathryne Esperdy & Donald D. Shillady, Ph.D., Department of Chemistry, Virginia Commonwealth University, Richmond, Virginia 23284. The geometry optimization and vibrational analysis of some well studied gadolinium complexes were performed in order to assess whether GAMESS could accurately model the site geometry and coordination number of gadolinium(III) in polyimide hosts. Computer simulated infrared spectra of anhydrous gadolinium formate, anhydrous gadolinium acetate, and Gd(III) complexed amic-acid sites in polyimides were generated from the Hessian output of the ROHF method in GAMESS. The profile and band frequencies of these calculated spectra were compared with experimental data of the compounds from 4000 to 50 cm^{-1}. The low frequency bands for the Gd-O stretching mode and the O-C-O ring distortion show excellent agreement in all compounds proving that GAMESS can accurately predict which ligands are bound in the coordination sphere of unknown complexes. The prediction of C.N. and geometry by GAMESS remains inconclusive until more models of the hydrated complexes can be completed.

VTFT – SOFTWARE FOR OFF-LINE FTNMR DATA PROCESSING. Harold M. Bell, Department of Chemistry, Virginia Tech, Blacksburg, VA 24061. With the advent of high-field NMR and the tendency to plot spectra on letter-size paper, today's spectra have too much data squeezed into a small space. One remedy is to require the student to make expanded plots prior to departing the NMR console. However, this is time consuming and inefficient. Also, the student may not know exactly what it is that he needs to do at that point in time. A better approach is to provide the students with the FID and appropriate software and let them process the data off-line. Program VTFT was written for off-line processing of FIDs captured in various formats (JCAMP, NUTS, LYBRICS, VARIAN UNITY. Etc.). It is a freeware 32 bit application for the PC platform operating under Windows 95. Provision is made for exponential smoothing, resolution enhancement, zero filling, scale expansion, peak picking, baseline flattening, and spectrum integration. Also, the spectrum may be plotted on any Windows printer, or exported as a Windows metafile. A companion application, FIDMAKER, can be used create FIDs in JCAMP format. This is useful in cases where students do not have access to FTNMR. The simulated FIDs are indistinguishable from the real thing.

SYNTHEIS OF FUNCTIONALIZED 3-AMINOMETHYLINDOLES. James H. Wynne & Wayne M. Stalick, Dept. of Chem., George Mason Univ., Fairfax, VA 22030. A variety of 3-substituted indole alkaloids are attractive targets in the search for novel Xa inhibitor agents in the coagulation process as well as for potential antidepressants. We report a novel efficient synthetic approach, which allows for the incorporation of diverse aromatic functionalities into the 3-position of the indole ring through a unique synthetic technique employing a variety of aromatic tosylaldimines, affording a library of 3-aminomethylindoles. The 3-aminomethylindoles can be converted into the corresponding tetrahydro- -carboline derivatives through a simple two-step approach involving substitution, followed by subsequent intramolecular cyclization employing a Lewis Acid. This method likewise affords a series of highly functionalized 1,4-disubstituted-tetrahydro- -carbolines. The current synthetic approach is designed to incorporate changes in the chelating ability by varying substitution in two positions within each molecule. The design and synthesis of these potential inhibitors will be discussed.

METHODS FOR SYNTHESIZING ALKYL PYRIDINES AND QUINOLINES FOR PYROLYSIS. Wayne M. Stalick, Chemistry Department, George Mason University, Fairfax, VA 22030. Our laboratory has been working in collaboration with NRL and as such, has been interested in fuels for Navy jets. Shale derived fuels are of interest because they have the highest alkane content, about 40%. Checking the alkane content of crude shale oil, however, shows a content of only 14%. Since the crude undergoes processing known as delayed coking, it is assumed that the extra alkanes are produced during this process. Like all crude, shale oil contains a large proportion of alkyl aromatic compounds, and it is assumed that their decomposition is responsible for the increased alkane content found. About 40% of the compounds in shale oil contain nitrogen, and of these alkyl pyridines and quinolines are the most prevalent. The idea of this project is to synthesize a number of model compounds to study under pyrolysis conditions to determine if they are the major source of the extra alkanes found in shale derived fuels. The general synthesis for these compounds has been a liquid ammonia/alkali amide system. Since the 3-substituted pyridines and quinolines are less basic that the 2- and 4- counterparts, they required other synthetic modifications and techniques. This report will cover all of the methods employed in making this series of model compounds.

DEVELOPMENT OF A LOW COST MULTI-WAVELENGTH COLORIMETER FOR THE CHEMISTRY LABORATORY. David M. Hendrickson & Harold F. Webster, Dept. of Chemistry & Physics, Radford University, Radford, VA 24141. Commercial colorimeters are marketed at costs that are sometimes prohibitive for general student use, yet colorimeters are useful for experiments involving stoichiometry, Beer's Law, chemical kinetics, and chemical equilibrium. The authors have developed a low cost colorimeter constructed of almost exclusively off-the-shelf products and a multi-colored LED. The instrument generates blue, red, or green light, and can combine these colors. The design makes protection from ambient light unnecessary, and enables software control of the instrument through an simple serial interface. Zeroing, calibration, and amplification were controlled by Labview^{TM} software, which also enables real-time monitoring and the ability to average incoming data. The authors tested performance using Beer's law plots and kinetics experiments involving the reaction between commercial food dyes and sodium hypochlorite were performed using the device.

ANALYSIS OF THE SELECTIVE OXIDATION OF POLYPHENYLENE SULFIDE. H. Francis Webster, Dept. of Chemistry & Physics, Radford University, Radford, VA 24141. The main focus of this research was to develop methods to chemically modify the surface chemistry of polyphenylene sulfide (PPS). Methodology has been developed to create a relatively thick surface layer where most of the polymer sulfide has been converted to sulfoxide or sulfone. Potassium persulfate was effective in selectively oxidizing the sulfur group to sulfoxide, while an acetic acid / hydrogen peroxide mixture converted the sulfide first to sulfoxide and then to sulfone. The reaction kinetics at various temperatures were studied using infrared attenuated total reflectance (ATR) by monitoring the appearance of new sulfoxide or sulfone IR bands. X-ray photoelectron spectroscopy (XPS) was also used to document the conversion to sulfoxide and sulfone by following the increase in the sulfur 2p photopeak position from 164 eV to 166 (sulfoxide) or 168 eV (sulfone). ATR indicated that the modified layer was relatively thick (>10 nm).

COMPLEXES OF THE N-(4-DIMETHYLAMINOPHENYL)PHTHALAMATE LIGAND WITH Co(II), Ni(II), Cu(II), AND Zn(II): A RESEARCH-ORIENTED SENIOR-LEVEL LABORATORY COURSE. Julie Phillips, D.L. Polo & L. M. Vallarino (CHEM 406L), Department of Chemistry, Virginia Commonwealth University, Richmond, VA 23284-2006. This work is part of an ongoing class 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-dimethylaminophenyl)phthalamic acid (HDiMeNPPA), synthesized from N,N-dimethyl-1,4-phenylenediamine and phthalic anhydride, was reacted with the metal acetates to yield compounds of the general formula $M(DiMeNPPA)_2\ \{M(CH_3COO)_2\}_n\ (H_2O)_m$, where n = 0.5 for Co(II) and Ni(II), 0.25 for Cu(II) and 0 for Zn(II). 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 ^{1}H NMR spectrum of the Zn(II) species, these complexes were tentatively assigned an octahedral coordination geometry with the $DiMeNPPA^-$ 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.

DEVELOPMENT OF A LOW COST MULTI-WAVELENGTH COLORIMETER FOR THE CHEMISTRY LABORATORY. David M. Hendrickson & Harold F. Webster, Dept. of Chemistry & Physics, Radford University, Radford, VA 24141. Commercial colorimeters are marketed at costs that are prohibitive for many chemistry departments, yet colorimeters are useful for experiments involving stoichiometry, Beer's Law, chemical kinetics, and chemical equilibrium. The authors have developed a low cost colorimeter constructed of almost exclusively off-the-shelf products and a multi-colored LED. The instrument consists of 3 manual switches to radiate blue, red, green, or combinations of those wavelengths. The design makes protection from ambient light unnecessary, and enables software control of the instrument through an A/D interface. Zeroing, calibration, and amplification are controlled by Labview software, which also enables real-time monitoring and the ability to average incoming data. The authors performed a kinetics experiment involving the reaction between a commercial blue food dye and sodium hypochlorite, and effectively show a first order reaction with respect to the food dye with a correlation coefficient of better than 0.995.

USING WEBCT IN ORGANIC CHEMISTRY CLASS. Christine K. F. Hermann, Chemistry and Physics Department, Radford University, Radford, VA 24142. WebCt is a World Wide Web-based educational tool that facilitates getting information to students. The faculty and students connect to WebCt through a web browser, making it very accessible. The students in my Organic Chemistry class can access their class WebCt page through a login and password. No one else can log into their class page. As a designer, I am able to create a series of icons that students can click on. In the calendar, students can view the dates for quizzes and tests, the names of the upcoming labs, and other announcements for the class. Internet links can be placed in the calendar. I have placed my schedule and contact information under professor information. Students can open and print blank quizzes, blank tests, and their answer keys. Students can email one another within the class and also place their own messages on a class bulletin board. When a student logs in and checks his grade, only that student's individual grades are seen. A graph of the other grades on a particular quiz or test can be brought up. Because of the nature of the Organic Chemistry quizzes and tests, the on-line quizzes tool is not utilized. If this feature is utilized, the on-line quizzes are automatically graded. The different aspects of WebCt will be shown in this presentation.

FORMATION, STRUCTURE AND PERFORMANCE OF CORROSION RESISTANT COATINGS ON AEROSPACE ALUMINUM ALLOYS. M. Todd Coolbaugh, Howard P. Groger & Sarah E. Morris, American Research Corporation of Virginia, Radford, VA 24143, arcova@swva.net. Aerospace aluminum alloys, especially Al2024-T3 and Al7075-T6, are prone to severe corrosion in marine environments. Traditionally this problem has been countered by the use of corrosion resistant coatings, i.e. conversion coatings, deposited from chromate-based formulations. Chromates have been shown to be highly toxic and mutagenic and there is intense pressure to eliminate their use. A simple, effective conversion coating based on zirconium and trivalent chromium has been developed and is undergoing field tests. The new trivalent chromium conversion coatings (tccc) have been shown to be effective in preventing both general- and pitting corrosion on Al2024-T2, and very effectively enhances adhesion of paints and adhesives to aluminum. Although the effectiveness of this new conversion coating has been demonstrated, the mechanism of its formation remains an interesting question. To probe this question, a number of surface sensitive spectroscopic tools were utilized in order to determine the composition and structure of the tccc. A possible mechanism for the formation of the tccc will also be presented.

MULTILAYER MOLECULAR SELF-ASSEMBLED THIN FILM SENSORS FOR DETECTION OF AMMONIA, K. P. Lo, E. C. Aquino, H. P. Groger, R. J. Churchill, American Research Corporation of Virginia, P.O. Box 3406, 1509 Fourth Street, Radford, VA 24143-3406. An optical sensor system based on multilayer molecular self-assembled thin films for detection of ammonia has been demonstrated. The sensing film was fabricated by immobilizing pH sensitive fluorophores in self-assembled polyelectrolyte films. Fluorescence from the thin film was excited by a laser diode and was detected using a total-internal-reflection geometry. The response of the thin film to different concentrations of ammonia vapor was characterized in the absorption and fluorescent modes. The sensor system has been demonstrated to response reversibly to ammonia at concentrations less than 41 parts-per-billion with response and cleardown times in approximately three minutes. The estimated detection range for the sensor is between 10ppb to 20ppm.

SYNTHESIS OF LONG CHAIN FUNCTIONALIZED ALKYL QUINOLINES. Leo C. DeSesso & Wayne M. Stalick, Dept. of Chem., George Mason Univ., Fairfax, VA 22030. There are many examples of functionalized alkyl quinolines with medicinal uses that have been described in the literature and many of these have not been obtained in large quantities. Because molecules of this type are not commercially available, nor has their synthesis been reported in the literature, we sought to develop a new methodology that would afford a variety of alkyl quinolines, even in the presence of several pH sensitive functionalities. We report a novel efficient synthesis of the aforementioned compounds by a variety of methods, both with and without the implication of a protecting group. Treatment of the starting material with a strong base, followed by intermolecular substitution employing a variety of alkyl halides, affords the desired compounds. By varying the alkyl halide employed the side chain can easily be altered to the desired length. The synthetic strategy, reaction conditions, and classification of these types of compounds will be discussed in detail.

ENVIRONMENTALLY FRIENDLY CATALYTIC OXIDATION UNDER PHASE TRANSFER CONDITIONS. Christopher T. Lloyd, James H. Wynne & George W. Mushrush, Dept. of Chem., George Mason Univ., Fairfax, VA 22030. A new, efficient, environmentally friendly method for the selective oxidation of alcohols into their corresponding aldehydes is needed. Many current methodologies require unfavorable conditions and often proceed with low yields. We report the selective oxidation of primary alcohols to the respective aldehyde under ambient, neutral conditions employing an oxotriruthenium cluster complex and a phase transfer catalyst (PTC) system. At catalytic concentrations, the oxotriruthenium complex effectively promoted the transformation of primary alkyl alcohol into the corresponding aldehyde with little or no over-oxidation. The PTC is believed to play a dual role in the extraction of the metal catalyst and the oxidant from the aqueous layer. More remarkably, the tetraalkylammonium salts are believed to prevent deactivation of the ruthenium catalyst. Yields in excess of 70% with greater than 95% selectivity have been achieved on a variety of substrates. The ability of the reaction to proceed under such mild conditions represents an invaluable, environmentally friendly route to effectively oxidize primary alcohols. Reactions conditions for this oxidative process will be discussed.

DIELS-ALDER ADDUCTS OF PRENYLINDOLES FROM THE ROOT BARK OF THE TANZANIAN PLANT *MONODORA GRANDIDIERI*. Godson C. Nwokogu, Department of Chemistry, Hampton University, Hampton, VA 23668. Four compounds were isolated from the root bark of the annonaceous plant, *Monodora grandidieri,* collected from the Udzungwa National Forest Reserve in Tanzania. Mass spectra, melting points and chemical shifts are consistent with the assignment of the 6-prenylindole structures 1 and 2 to components C_1 and C_2 respectively. The mass spectra of components C_3 and C_4 suggest that these compounds are dimers and their fragmentation patterns suggest that C_3 could be a 1:1 Diels-Alder adduct of 1 and 2 while

C_4 could be a Diels-Alder homoadduct of 2. The structurally preferred endo/ortho diastereomeric adducts from such cycloadditions are 3 and 4 for components C_3 and C_4 respectively. The stereochemistry and stereochemical composition of C_3 and C_4 have not been established yet.

CHARACTERIZATION OF MOUSE AND HUMAN GUANINE-7-METHYLTRANS-FERASE. David J. Bautz, Sara Zulfiqar, Keith Newbrough & Thomas Sitz, Dept. of Biochemistry, Virginia Tech, Blacksburg, VA 24061. The methylation of the 7-position in the guanine base in the cap structure located at the 5'-end of eucaryotic mRNAs is essential for ribosome binding and translation. We have received a clone of the human guanine-7-methyltransferse expressed in *E. coli* as a fusion protein with glutathionine transferase from Dr. Shatkin. The coding sequence for this cDNA predicts an enzyme of 55K molecular weight. We used the human sequence to search the mouse genome database and found 7 ESTs that encompass the entire coding sequence for the methyltransferase in mouse. This sequence predicted a molecular weight of 53K, significantly larger than the mouse enzyme *in situ.* We determined that the molecular weight of the mouse enzyme isolated from tissue was 46K in size. When the human and mouse sequences were compared, we found that the n-terminal region of about 120 amino acids was poorly conserved while the rest of the protein was almost identical. We have produced a clone of the human methyltransferase with the n-terminal 120 amino acids deleted, generating a protein of about 42K molecular weight. We are currently characterizing this shortened enzyme for activity and stability.

PLATINUM(IV) TETRAPHENYLPORPHYRIN DIBROMIDE COMPLEXES: SYNTHESIS, CHARACTERIZATION, AND ELECTROCHEMISTRY. R. K. Boggess[1], H. Washburn[1], D. I. Grove[1], L. M. Mink[2], J. W. Voce[2], J. E. Ingersoll[2], & V. T. Nguyen[2], [1]Department of Chemistry and Physics, Radford University, Radford, VA 24142, [2]Chemistry Department, California State University, San Bernardino, CA 92407-2397. Platinum(IV) porphyrins of the type $[Pt^{IV}(p\text{-}X)_4TPP]Br_2$ where $(p\text{-}X)_4TPP$ is a *para*-substituted tetraphenylporphyrin have been synthesized by the direct oxidation of their Pt(II) precursors with Br_2. Both the Pt(II) and Pt(IV) complexes have been characterized by visible and ^1H NMR spectroscopy and their electrochemical properties. In both the oxidation and reduction processes, a substituent effect is evident and the reduction of Pt^{IV} Pt^{II} is identified. The oxidation and reduction potentials of the $[Pt^{IV}(p\text{-}X)_4TPP]Br_2$ complexes are compared to their $[Pt^{II}p\text{-}X)_4TPP]$ precursors and $[Pt^{IV}(p\text{-}X)_4TPP]Cl_2$ analogues.

VIBRATIONAL SPECTROSCOPY IN THE STUDY OF SOLID SURFACES. James P. Wightman, Dept. of Chem., Va. Polytechnic Inst. & State Univ., Blacksburg, Va 24061. Infrared spectroscopy (IRS) is a useful technique to identify functional groups on solid surfaces. Solid powders having high specific surface areas can be run in the trans-mission mode either as a KBr pellet or as a self-supporting neat disc. However, for low surface area or infrared absorbing solids, IR spectra has to be taken in the reflectance mode. There are a number of reflectance attachments available for use on commercial IR spectrophotometers. IR spectra of both high and low surface area solids obtained by the use of transmission, attenuated total reflectance, specular reflection, diffuse reflectance and photoacoustic attachments will be shown. Thus, IRS is a powerful analytical tool to study solid surfaces by appropriate choice of an attachment. Application areas include heterogeneous catalysis, surface contamina-tion, adhesion, thin film analysis, and composite degradation.

COMPUTERIZED MOLECULAR DESIGN OF A HEPARIN PENTASACCHARIDE MIMIC. Gunnar T. Gunnarsson & Umesh R. Desai. Dept. of Med. Chem., School of Pharmacy, VCU, Richmond, Va 23298. The anticoagulant heparin activates human plasma protein antithrombin to inhibit factor Xa and thrombin, two critical coagulation proteases. A sequence of five saccharides in heparin specifically recognizes the heparin-binding site in antithrombin and activates the inhibitor to rapidly inhibit these clotting enzymes. This pentasaccharide sequence, called DEFGH, has been the focus of recent clinical studies as a replacement for heparin and low molecular weight (LMW) heparins. Our earlier studies have shown that DEF binds and activates antithrombin equally well as DEFGH. The current study presents a design of a new organic molecule that mimics the trisaccharide DEF. Modeling programs such as *SYBYL* and *Flexidock* were used in the molecular design while the ligand-protein complex was analyzed using *HINT*. *HINT* analyzes gives a score that defines non-covalent interactions including hydrogen bond, polar and hydrophobic interactions. Comparison of the trisaccharide DEF and our designed bis-decalin derivative, v14, with antithrombin shows that both molecules give high positive *HINT* interaction scores. The modeling study suggests that v14 mimics the DEF portion of the heparin pentasaccharide and could be a potential anticoagulant.

INFLUENCE OF INTRAMOLECULAR HYDROGEN BONDING ON THE REACTIVITY OF THE ENAMINONES OF THE BARBITURIC ACID DERIVATIVES. Dmitry Pestov, Dept. of Chem. Eng., Virginia Commonwealth University, Richmond VA, 23284. The kinetics of the transamination of 1,3-dimethyl-5-anilinomethylenebarbituric acid (1) and 1,3-dimethyl-5-N-methyl-anilinomethylenebarbituric acid (2) by mono- and diamines in 2-propanol and in DMSO was studied. The first compound has intramolecular hydrogen bond (HB) and second does not. It was found that compound (2) reacts with monoethanolamine in 2-propanole medium in 10^5 times faster then compound (1). A mechanism of the reaction with tetrahedral intermediates was suggested and confirmed by a good correlation with experimental and theoretical data. The presence of intramolecular HB in substrate (1) considerably reduces speed of the reaction by decreasing of the amount of intermediate T1 at the first step of the reaction. The presence of the intramolecular HB in intermediates T1 and T2 slows down a proton exchange in T1/T2. This step became a limiting factor for the rate of the whole reaction.

Computer Science

Education

COAST TO COAST 2000. FINDING A LAND ETHIC: INVESTIGATIONS IN NATURAL RESOURCE MANAGEMENT. Myron E. Blosser Harrisonburg High School. Education is only fully realized when it is lived. We do very well at giving our students tremendous quantities of facts. Do we provide them with enough experience living in the world and applying their knowledge? How much of our education has students meeting people with different ideas, applying concepts to current issues, solving real-life problems, and realizing that their presence will indeed change their corner of the world? In the hopes of making education experiential and our students' real scientists who indeed live their education, the vision for Coast to Coast 2000 was born. An initiative developed by Harrisonburg High School science faculty, the program seeks to connect the real world with the classroom. In fact, Coast to Coast 2000 is an educational venture where the learner ís classroom is the entire nation for 22 high school students and six science faculty during their 34-day cross-country investigative trip. They will board a chartered bus equipped with computer workstations, Internet access, test kits, and probe ware. Participants will visit over 25 states, camping and study in 11 national parks. To increase dialogue they will update their web site at www.shentel.net/cst2cst.

USING CASE VIGNETTES AND SCENARIOS TO ADDRESS INSTRUCTIONAL ISSUES IN SCIENCE. Alvin M. Pettus, James Madison University, Harrisonburg, Va. Case methods provide viable options for instruction in science. Short cases and scenarios that focus on specific topics can be studied and discussed during a class session or a part of a class session to develop awareness of science issues, develop problem solving skills, assess attitudes, assess levels of understanding, and motivate students. Examples of vignettes, scenarios, and short cases were presented and different structures for discussing them were shared. Some examples included science teacher education issues. Other examples included the application of science concepts by secondary school students. Cases can be written by the teacher and/or students or they can be descriptions of real situations.

NINETEENTH CENTURY GEOGRAPHY: 21ST CENTURY'S INTERDISCIPLINARY SCIENCE? Pamela C. Turpin, Roanoke College, Salem, Va. In 1893, the Committee on Secondary Education met to discuss what subjects were to be taught in secondary schools. The sciences were broken up into separate disciplines in order to accomplish this. One of these was the section on geography. This section seemed in several ways to exceed the expectations of the overall committee. They laid a framework for instruction in geography in public schools from the elementary grades through high school. This section also provided in their report the ways and means of accomplishing the goals they set. An examination of the content and methods of instruction set forth in their section report reveal an interdisciplinary approach to teaching science. This nineteenth century report shows us involved in 21st century science instruction that even though some things have changed in instructional methods there are prevalent ideas and ideals in both centuries that remain the same in science instruction.

BIOETHICS 2000 AND LIFE SCIENCES: PROGRAMS, RESOURCES, AND EXHIBITIONS. E. G. Maurakis, Science Museum of Virginia, 2500 W. Broad St., Richmond, VA 23220. Bioethics 2000 is an educational initiative to increase understanding of bioethical issues in organ donation and genetics. Bioethics 2000 presents bioethical information via theatrical plays, lectures, panel discussions, workshops, web pages, curriculum guides, and videos. Bioscape, the Science Museum's new permanent Life Sciences Exhibition, will open during autumn 2000. Bioscape, covering 10,000 ft^2, is composed of 69 exhibits that contain hundreds of interactive experiences in four galleries: Molecular Biology/Genetics; Human Biology/Health Sciences; Environmental Sciences, and Biological Timing. An interactive 60-foot tall model of the DNA molecule in the Museum's East Stairwell will be the centerpiece of the galleries. Bioscape is supported by gallery demonstrations, Discovery Tours (VA S.O.L. tours of Bioscape), Mini-Med School, Mini- School of Marine Science, Funsten Lecture Series, Bioethics 2000, teacher workshops, internet resources, 10 SOL-based teacher resource curriculum guides, and more. Bioethics 2000 is funded by the Greenwall Foundation.

USING BIOLOGY CURRICULUM TO INCREASE PROFICIENCY IN MATH SOLS. J. McLaughlin, Instructional Leader for Math and Science, Lord Botetourt High School, Botetourt County Schools. In order for students to make connections between mathematical concepts and their applications in lab, as well as to prepare students for college, there is a need to incorporate more mathematical skills in introductory high school Biology labs. An effective way to implement this idea is to adopt an Algebra/Biology informal team teaching methodology, consisting of 2 teachers "teaming" individual preparations. The math concepts taught in Algebra will be immediately seen in their applications in the Biology lab. Many school systems have been slow to adopt a formal teaming approach because of its drawbacks, i.e.. scheduling, organization of material. However, with a somewhat less rigid teaming approach, students can benefit from constant reinforcement of algebraic concepts. If Biology students enroll in Chemistry the next year, they will have a stronger base for algebraic concepts, and retain a better understanding of data collecting in the sciences as seen in different settings. Teachers will develop a better understanding of intra-curriculum concepts by being exposed to different teaching techniques and ideas while better recognizing remedial targets by developing a more comprehensive student portfolio.

ENVIORNMENT-PEOPLE-INTERACTIONS:SOUTHERN AFRICA AS A FOCUS STUDY FOR THE PROFESSIONAL DEVELOPMENT OF SCIENCE TEACHERS. Michael Bentley, Virginia Tech, Blackburg Va. Few teachers have studied Africa and the continent is underrepresented in Virginia's K-12 curriculum. Virginia Tech's Department of Teaching and Learning has initiated the Southern African Studies Institute for Teachers, a two-year summer professional development program for teachers culminating in a multi-country field trip to Southern Africa. The program focuses upon key aspects of African society - history, economics, geography, government, education, social life, etc., and the types of habitats and wildlife found there. Social science and ecological concepts are integrated through examining social and ecological issues. Participants develop classroom portfolios as they infuse African studies into their local curriculum. Pre- and post-experience data will be collected for evaluation. The program web site is http://www.chre.vt.edu/sa_inst .

BIOSCAPE: VA S.O.L. TOURS IN SCIENCE MUSEUM'S NEW EXHIBITION GALLERIES. A. Clarke Hamm, T. D. Green, T. Kitts, E. G. Maurakis & S. Short, Science Museum of VA, 2500 W. Broad St., Richmond, VA 23220. The Standards of Learning (S.O.L.) tours, now called Discovery Tours: Science S.O.L. Connections, are newly developed materials correlating the museum's new 70 permanent life science exhibits with the Virginia S.O.L.s. Tours offer teachers and students a well-planned museum visit with hands-on learning, and provide classroom activities to reinforce the museum experience. Discovery Tours are divided into the following three formats. Materials for grades K–4 consist of chaperone-led tours with questions and answers for chaperones to ask at grade-appropriate exhibits, along with in-class activities for teacher use. Materials for grades 5–8 consist of scavenger hunts that students complete in groups while visiting the museum, as well as follow-up classroom projects. High school tours are student projects on specific life science topics. Students complete questions using museum exhibits and other resources; and then use their information to conduct an experiment or design a product that can be used to teach others about the topic. Discovery Tours: Science S.O.L. Connections will be available in fall 2000 to educators booking a group visit and on the Science Museum of Virginia website. This project was funded in part by the Robins Foundation.

TEACHING BIOLOGY THROUGH INNOVATIVE ASSIGNMENTS. J. Orion Rogers, Dept. of Biol., Radford Univ., Radford, VA 24142. Learning is a creative endeavor. Innovative assignments that emphasize application and experience enrich and motivate student learning. Both individual and group writing activities and oral presentations have been used successfully to provide personal interaction with material, foster active learning, promote cooperation among students, provide structured time on task, enhance scientific reasoning skills and integrate knowledge. Writing activities supplement and complement traditional instructional techniques by enhancing library research skills, awareness of the scientific literature, and knowledge of biology beyond what can be covered in class. Examples of writing assignments that can be used include: term papers, grant proposals, journals, letters of biological concern, brochures, critiques, reviews, posters, quantitative exercises, science fiction stories, medical mysteries and biographies and case studies. Writing assignments stimulated students and encouraged them to take more responsibility for their own learning. Students who completed these assignments commented that writing was a positive influence on their learning, and the skills they developed would be used in future courses. Students developed self-confidence as they were forced to think laterally and critically and realized implications and applications from unique perspectives.

RARE PLANTS IN THE CLASSROOM; POTOMAC ELEMENTARY SCHOOL AND THE TOYOTA TAPESTRY GRANT. P. Sheridan[1&2], R. Horman[1], S. Horman[1], S. Gilbert[3], A. Keeton[3], & M. Schmutte[3], [1]Meadowview Biol. Research Station, [2]Dept. of Biol. Sciences, Old Dominion Univ., and [3]Potomac Elementary School. A basic challenge to educators is how to get young students involved and interested in science and biological conservation. We utilized the carnivorous yellow pitcher plant and longleaf pine to capture students imagination, answer important scientific questions, and make significant contributions to rare species recovery. We used the Toyota Tapestry Grant to fund and develop our program of scientific study and rare plant reintroduction. Students found that freezing had no effect on breaking dormancy in yellow pitcher plant seed while dilute fertilizer and soil amendments such as Miracid, Superthrive, and a solution of burned pitcher plant leaves significantly increased seedling growth over controls. Students returned over 300 pitcher plant and 95 longleaf pine seedlings to a VDOT wetland mitigation site within the historic range of the species. We think that an important reason for the success of the project was the team effort between teachers, local volunteer master gardeners, and scientific mentors. Student efforts continue with both species in a school yard “mini-nursery”.

A METHOD FOR PLANTING LONGLEAF PINE, *PINUS PALUSTRIS* MILLER, ON HIGHWAY RIGHTS-OF-WAY. Phil Sheridan, Meadowview Biological Research Station and Department of Biological Sciences, Old Dominion University. Longleaf pine is a very rare plant in Virginia with only 4432 trees remaining in the wild. We were interested in utilizing highway rights-of-way to start backup populations of native Virginia longleaf pine within the historic range of the tree and to measure survivorship of longleaf pine planting. Two hundred seventeen seedlings with an average root collar diameter of 1 cm were planted in a cloverleaf in Prince George County, Virginia in mid-January 1999. Ground cover cloth was placed around each seedling, mulch was placed on top of ground cloth, and a bamboo stake with survey tape placed next to each seedling. Mowing of the site during the growing season was carefully coordinated with VDOT staff. Survivorship of longleaf pine after one season was 84% and mulching generally provided effective control of longleaf pine competitors.

COMPARISON OF INSECT CAPTURES BETWEEN WILD-TYPE AND MUTANT GREEN *SARRACENIA JONESII* WHERRY. Phil Sheridan[1&2], Jonathan Humphrey[1], Monique Davies[1], Chris Simon[1], & Nancy Penick[1], [1]Meadowview Biological Research Station and [2]Department of Biological Sciences, Old Dominion University. Various investigators have proposed that insects are attracted to the carnivorous *Sarracenia* pitcher plants by color, nectar, and scent. Mutant pitcher plants exist which lack the ability to produce reddish-purple pigment due to a recessive allele blocking a late stage of anthocyanin biosynthesis. Normal wild-type plants of *Sarracenia jonesii* produce only cyanidin and thus the role of anthocyanin in capturing insects may be assesed through comparative studies of insect captures between wild-types and mutants. We raised both wild-type and mutant plants from seed and measured pitcher height, mouth width, and mass of insect captures in the 3 year old seedlings. We found that pitcher height and mass of insects captured by mutants was significantly greater than wild-type while there was no significant difference in mouth width.

THE YELLOW PITCHER PLANT, *SARRACENIA FLAVA* L., RECOVERY PROGRAM. Phil Sheridan, Meadowview Biological Research Station and Department of Biological Sciences, Old Dominion University. The yellow pitcher plant is a carnivorous plant restricted to fire maintained wetland ecosystems in Virginia. Due to land use changes and urban development this species has suffered significant population declines resulting in only four native populations remaining totaling less than 100 plants. Through a careful process of scientific research an effort to return the yellow pitcher plant to its historic range in Virginia is now being undertaken. This process includes: continued field research for new populations; propagation of extant and extirpated colonies; ecological and reproductive biology studies; reintroduction to the wild of both site-faithful and mixed populations; education of the general public about the importance of these plants and their environment; active programs with local schools involving them in various scientific aspects and on-site reintroductions; a registry with state agencies of all introduced sites, material planted, and origin of stock. A population has now been started in five of the eight historic counties for this species. State highway rights-of-way and wetland mitigation projects have been used for half the reintroductions with several of the sites in their third successful year of reproduction.

ROOTING LONGLEAF PINE, *PINUS PALUSTRIS* MILLER, FROM NEEDLE FASCICLES. Phil Sheridan[1&2] , Kneeland Nesius[2], & Leslie Everett[2], [1]Meadowview Biological Research Station and [2]Department of Biological Sciences, Old Dominion University. Longleaf pine is a rare plant in Virginia with only 4432 trees remaining in the wild in the state. Cone crops can be erratic and seed yields per cone are less than the average reported for southern provenance. We were interested in determining the feasibility of regenerating rare Virginia longleaf pine from needle fascicles. If we can successfully regenerate native longleaf pine trees from needle fascicles than we can compensate for erratic seed production and, more importantly, capture the entire longleaf pine genome in Virginia for conservation purposes. Our initial efforts have focused on replicating other workers results with grass stage seedlings. Up to 65% of fascicles from a seedling can produce roots when placed in a 2 cm deep solution of 100 ppm IBA for 24 hours followed by maintenance in a solution of 60 ppm H_3BO_3, 40 ppm NH_4NO_3, and 20 ppm thiamine-HCl.

Environmental Science

THE NONEQUILIBRIUM THEORY OF DISTRIBUTION AS INDICATED BY DIATOM PERIPHYTON SPECIES. Mariah Butler and Stephen Gough, Dept. of Biological Sciences, Mary Washington College, Fredericksburg, VA 22401. A study of whether nonequilibrium community dynamics occurs among periphytic diatoms in a riffle zone of a small stream environment was conducted in the spring of 2000. Among other things, nonequilibrium tenants state that patchiness can exist, even in areas that are geographically close by and appear uniform in habitat. We chose to use a bar clamp collecting devise, collecting 40 random samples from rocks in a five m^2 area representing apparent environmental uniformity. Sampling followed heavy rains in which water and sand scoured the rocks. The samples were analyzed for the types and numbers of diatoms present. The data indicated wide variability in total numbers of the organisms, though there were only three species present. The results were attributable to the disturbance caused by the strong flows and sand, and the variety in species counts and the low diversity suggested patchiness and preliminary recolonization, thus supporting the view that nonequilibrium community dynamics were present at the site. It is possible that periphyton communities in this area rebound to near equilibrium after perturbations, but are almost always recovering from the last disturbance.

THE FATE OF INORGANIC PHOSPHORUS AND NITROGEN IN WATERS FLOWING THROUGH AN URBAN FRESHWATER MARSH. Stephen B. Gough & Tiffany L. Patrick, Dept. of Biological Sciences, Mary Washington College, Fredericksburg, VA 22401. We tested a constructed wetland in an urban environment to determine whether nitrate and phosphorus were being transformed, or whether the site acted as a sink or a source for the substances. Guided by some studies in the literature, our hypothesis was that some retention of each would occur. Samples were taken from October 1999 to March 2000. On average, nitrate-nitrogen from the inflow to the outflow was reduced 15% and orthophosphate was decreased by 23%. However, there was considerable variability in reduction rates at different times of the year, with phosphorus and nitrate showing disparate seasonal trends. Nitrate was reduced significantly from October until January. In the latter month and into February release went up considerably. Conversely, phosphorus output peaked in November, at a time when inflow concentrations were the greatest. Despite some retention rates for both nutrients, hydrophyte uptake may not have played an important factor in uptake except for nitrates in the early fall and winter. Phosphorus early release rates may have been due to decomposition with concomitant outwashing.

ENVIRONMENTAL IMPACT OF COMMERCIAL AND AGRICULTURAL DEVELOPMENT ON FEEDER STREAMS OF THE RAPPAHANNOCK RIVER.J. Richardson, T Sheffield & M. L. Bass, Environmental Science & Geology Dept., March Washington College, Fredericksburg, VA 22401-5358.Land within the Rappahannock River Basin has been in forests or in agricultural production. However, the increased population growth of the area has created more urban land uses. Nonpoint source pollution runoff from agricultural and urban sources is a major problem in the basin. This research is a continuation of efforts to quantitatively analyze the water quality of tributary streams draining the Rappahannock River Basin. The macrobenthos and water quality in the England Run drainage basin and the unnamed stream system immediately to the west of it were analyzed. Effects of land use on stream morphology, water quality and macrobenthic diversity were assessed. Water samples were tested for nitrate,orthophosphate, pH, total dissolve solids, temperature and conductivity. In undeveloped areas, beaver dams created sediment traps and wetland conditions with the potential for absorbing nutrients. Values of total dissolved solids were greater in areas receiving drainage from impervious surfaces and pH values were acidic.Values of nitrate greater than 1ppm were found in areas where the stream ran through residential and agricultural regions. Macrobenthos scored fair to good (SOS) at most sites.

OUTLINE OF A PRELIMINARY STUDY OF THE EFFECTS OF DEVELOPMENT ON A SMALL WATERSHED. M. L. Bass & R. Strickler, Environmental Science & Geology Dept., Mary Washington College, Fredericksburg, VA 22401-5358. Previous work on two small streams feeding into the Rappahannock River has developed into an expanded study to include extensive water quality analyses, macrobenthic and periphyton community health and monitoring stream bank erosion. Planned development of a previously forested an agricultural area will increase the percentage of impervious surface in the watershed. Water quality analyses will include Pb, Zn, BOD, Fecal coliform along with basic testing. Previous work showed increases in nitrate and phosphate in residential and agricultural areas. Macrobenthos was analyzed using EPA Rapid Bioassessment Protocol showing decreased health with increased sedimentation of stream bed. The macrobenthic EPT % decreased from the headwaters to the mouth of the stream. Periphyton health was decreased by sedimentation. Streambank erosion is increasing as the area is developed both residentially and commercially. Further study of the streams is continuing.

A COMPARATIVE STUDY OF SMALLMOUTH BASS AND ROCK BASS DIETS IN THE NEW RIVER, VIRGINIA. Angela C. Benson & Tammy J. Newcomb, Va. Polytechnic Institute and State University. Smallmouth bass *Micropterus dolomieu* and rock bass *Ambloplites rupestris* are important game species in the New River. Recent observations indicate a shift towards larger sizes of smallmouth bass. We compared New River (1999) diet data to historical New River (1989) and Powell River (1989) data. Diets were analyzed by use of a chi-square test to compare prey items of similar-sized smallmouth bass and rock bass. The 1999 and 1989 New River comparison of smallmouth bass showed no difference in diet composition. Compared to 1999 New River data, Powell River smallmouth bass were significantly different and ate more insects and fewer fish. Powell River rock bass also consumed more insects and fish, and 1989 New River rock bass ate more megalopterans and fewer crayfish. New River smallmouth bass (1999) ate more insects and fish than the rock bass, and New River rock bass (1999) ate more crayfish and megalopterans than the smallmouth bass. We also found that smallmouth bass and rock bass of similar sizes are not eating the same proportions of prey items. (Supported by the Biological Sciences Initiative at Virginia Tech).

GASTRO-INTESTINAL DIFFERENCES IN BIRD SPECIES. Cristina R. Faustino and P. F. Scanlon. Dept. of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061-0321. Aspects of the gastrointestinal (GI) tracts of 10 bird species were examined and the lengths of cecal pouches (blind sacs at the junction of the small and large intestines) were compared to the overall lengths of the GI tract. (Cecal pouches were not considered in these GI tract "lengths"). Cecal pouches were absent or virtually absent in 2 species examined (Red-tailed hawk, *Buteo jamaicensis* and Mourning doves (*Zenaida macroura*). The other 8 species, numbers examined (N), and ratio of average single cecal pouch length to GI tract length (% basis) are given as follows: Bufflehead, *Bucephala clangula,* (N=1), 4.25%; Rock dove, *Columba livia*, (N=1), <1.00%; Japanese quail, *Coturnix c. japonica,* (N=4), 10.2%; Northern bobwhite, *Colinus virginianus,* (N=6), 9.35%; ring-necked pheasant, *Phasianus colchichus*, (N=2), 15.1%; Wild turkey, *Meleagris gallopavo,* (N=2), 15.1%; Chukar, *Alectoris chukar,* (N=1), 14.2%; Ruffed grouse, *Bonasa umbellus* (N=1), 42.9%, respectively. Cecal pouch length appears to increase substantially as the proportion of fibrous food material increases in the diet.

AN EVALUATION OF BROWN TROUT SPAWNING HABITAT IN A HYDROPEAKING TAILWATER. David A. Hewitt & Tammy J. Newcomb, Dept. of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061. Brown trout *Salmo trutta* provide an economically significant fishery in the Smith River tailwater below Philpott Dam, VA. Brown trout recruitment may be limited and could detrimentally impact the fishery. Using habitat suitability indices (HSIs), we calculated the amount of available spawning habitat in three sites below the dam. Sites were chosen based on relative abundances of age-0 brown trout because age-0 fish have been shown to be correlated with spawning areas. Microhabitat in the three sites was characterized by water depth, velocity, dominant substrate, and percent fines (substrate < 2 mm). High quality spawning habitat was limited, comprising no more than 6% of the total area of any of the sites. The most available spawning habitat was at the site closest to the dam. The least available spawning habitat was in site two, where the greatest abundance of age-0 brown trout were captured. Age-0 brown trout distribution was not correlated with high quality spawning areas. We suspect that daily releasing flows may affect their distribution by washing young fish downstream and affecting other important habitat features such as food availability and water quality.

THE EFFECTS OF HYDROLOGY ON *Chamaecyparis thyoides (B.)* B.S.P. GROWTH IN WETLAND RESTORATION EFFORTS. Kristin M. Shacochis, Jefferey W. DeBerry, Darren T. Loomis, Robert T. Belcher, and Robert B. Atkinson. Department of Biology, Chemistry, and Environmental Science, Newport News, VA 23601. During the 1900's Atlantic white cedar, *Chamaecyparis thyoides* (L.) B.S.P., an obligate wetland species, declined by over 90% in Virginia and North Carolina due to ditching, logging, and fire suppression (Laderman 1989). Red maple (*Acer rubrum*) a facultative species, and other hardwoods have replaced cedar as a dominant species in many areas. To better quantify stand composition change, importance values (IV) and weighted averages (WA) were calculated for all stratum in two intermediate (10 to 30 year old stands) sites and two mature (50 to 70 years old stands) sites located in the Great Dismal Swamp and Alligator River national Wildlife Refuges. Cedar had the highest importance in Alligator River intermediate site (196) while the lowest IV occurred in Alligator River mature site (138). Alligator River mature had the lowest WA (1.01) and the highest WA occurred in Dismal Swamp Intermediate (1.86). Since WA is a measure of plant response to hydrology, higher WA in Great Dismal Swamp National Wildlife Refuge suggests that low water tables may be contributing to cedar decline. (Supported by Environmental Protection Agency).

A SURVEY OF AQUATIC RESOURCES IN TOM'S CREEK AND AN ASSESSMENT OF THE EFFECTS OF RIPARIAN ZONE ALTERATIONS. Terry L. Smith II, Aquaculture/Fisheries Dept., Univ. of Arkansas, Pine Bluff, AR 71601 & Tammy J. Newcomb, Dept. Fisheries and Wildl. Sciences, Virginia Tech., Blacksburg, VA 24060. Tom's Creek basin, near Blacksburg,Virginia is slated for development which may result in changes in the riparian zone. We sampled physical stream habitat, water quality, and the fish community to determine baseline conditions and we used a temperature model to evaluate riparian losses. Discharge ranged from 74 to 347cm^3/s, the average stream width was 6.6 m and 40% of the stream was shaded. Dissolved oxygen and water temperature was high, 8.5 ppm and 26.2° C respectively. Nitrite was constant (0.05 ppm); nitrates ranged from 0.4 ppm to 0.2 ppm. Minnow species were most abundant and other species included smallmouth bass, sunfish, darters, madtoms, suckers, and the sculpins. On a summer day, removal of shading would increase the maximum daily temperature 1.2 – 2.7°C. The addition of shading would conversely reduce the maximum daily temperature by 1.64 – 3.3°C. Removal of the riparian zone along Tom's Creek would increase water temperature, which may result in changes in water quality and fish communities.

TEMPORAL AND SPATIAL PATTERNS IN USAF BIRD-STRIKE INCIDENTS, 1988-1997: IMPLICATIONS FOR MANAGEMENT. Christine A. Tedrow, P. F. Scanlon, J. A. Parkhurst, and S. L. McMullin. Dept. Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061-0321. Analysis of strike data is critical to determine the true economic costs of bird strikes, determine the magnitude of safety issues, and develop preventive measures. Analysis of USAF bird-strike data identified trends and indicated suggested relationships among factors contributing to damaging strikes. From FY 1988 through FY 1997, the annual mean was 2,668 bird strikes with peaks evident in fall and spring. Daylight and dusk were hazardous for bird strikes. More bird strikes occurred during airfield operations and when aircraft were operating at low altitudes (and when soaring birds are more numerous). Aircraft speed, phase of flight, bird taxonomic group, bird mass and aircraft group were the strongest predictors of damaging bird strikes. Bird strike rates were calculated for USAF aircraft. Bomber aircraft had the highest strike rate; these aircraft frequently fly long missions at low altitudes where they are likely to encounter birds. The analyses indicated that factors contributing to USAF bird strikes overlap and interact. The study allows recommendations for improving reporting of bird strikes and data management as well as make recommendations for airfield management. Results will enable USAF to better focus research on preventing bird strikes, and assess the effectiveness of bird management programs.

EROSION PATTERNS OF SHOT TYPES IN DUCK GIZZARDS. Kristina C. Walski, P. F. Scanlon, J. R. Craig, and M. H. Sherfy. Depts. of Fisheries and Wildlife Sciences and Geological Sciences, Virginia Tech, Blacksburg, VA 24061. Spent shot is frequently ingested by waterfowl and upland bird species and retained in the gizzards. Therein the shot are subjected to physical grinding and chemical erosion in the highly acidic gizzard environment. To study erosion patterns of shot in the gizzards of blue-winged teal (*Anas discors*) 3 #4 lead, copper-jacketed lead, or steel shot were force-fed to each of 3 adult teal. Shot were recovered from the gizzards after 1, 2 or 3 days, and prepared for light and electron microscopy. Copper-jacketed shot appeared to be of a darkened color after 3 days in the gizzard, presumably indicative of erosion of the copper jackets. Indentations in the surfaces of the latter shot were apparent with light microscopy. The surfaces of lead and steel shot did not indicate unusual chemical compounds or wear patterns. However, copper-jacketed shot recovered after 3 days in the gizzard had pits in the copper jackets beneath which there was substantial erosion of the underlying lead, the pits were manifest as discontinuous areas in the sections of the copper jackets.

Geography - Section Officers meeting only.

Geology

ENGINEERING GEOLOGIC EVALUATION OF ROCK SLOPE STABILITY AT NATURAL BRIDGE, VIRGINIA. Chester F. Watts[1], Gary K. Rogers[2], & Daniel R. Gilliam[1], [1]Department of Geology, Radford University, [2]Department of Civil Engineering, Virginia Military Institute. On Saturday October 23, 1999, a rockfall from beneath the arch of Natural Bridge Virginia resulted in a tourist fatality. A multidisciplinary advisory team was assembled on behalf of the owner by Dr. Rogers to examine stability of the archway as well as of the approach areas. Dr. Watts served as team engineering geologist. Remedial action was divided into three distinct operations: 1. rock scaling along gorge sidewalls and identification of potential future rock fall areas, 2. removal and/or stabilization of ceiling slabs underneath the arch, 3. development of short-term and long-term strategies for dealing with large potentially unstable rock formations identified along upstream and downstream approach areas to the arch. Janod Ltd of Canada scaled accessible sidewalls from ropes and secured rock slabs beneath the arch under the direction of the advisory team. Additional issues arose as work progressed, including questions regarding the use of the natural arch as a highway bridge for U.S. Route 11. The tourist attraction was reopened early in the spring of 2000.

SHRINK-SWELL PROPERTIES OF SOME CHESTERFIELD COUNTY SOILS. Jeff Pluta and W. C. Sherwood, Dept. of Geology and Environmental Science, James Madison Univ., Harrisonburg, VA 22807. Expansive soils in the United States are responsible for property damages ranging into the hundreds of millions of dollars each year. The shrink-swell behavior of soils is due to the presence of smectite days, the most common being montmorillonite. Over the past three decades, expansive soils in Chesterfield County, Virginia have caused extensive structural damage to homes and other structures. Geologists and soil scientists working in Chesterfield County commonly use Atterburg Limits tests to predict expansive soil behavior. In this study, 18 soils and their Atterburg Limits test results were obtained from a consultant working in the County. Each soil was tested for expansion using the Potential Volume change (PVC) meter. The PVC swell index ratings were as follows: Very High - one soil, High - nine soils, Moderate - six soils, and Low - two soils. Correlation coefficients were than calculated for PVC results vs. Atterburg Limits, natural moisture content, -200 fraction, % clay, and ratios of these. R^2 values were universally low, varying from a low of 0.003 to a high of 0.270. The 0.270 value was for PVC vs. Plasticity Index. The poor correlations appear to indicate that the use of Atterburg Limits to predict shrink-swell behavior in soils is a questionable practice and more research is needed to identify or develop a rapid and accurate test to predict soil expansion.

CREATING A CD-ROM FOR THE SCIENCE CLASSROOM ON VIRGINIA'S COASTAL PLAIN. Phyllis L. Newbill[1], Parvinder S. Sethi[1], Robert C. Whisonant[1] & Karen K. Cecil[2], [1]Radford Univ., Radford, VA 24142 and [2]Radford High School, Radford, VA 24141 & New River Community College, Dublin, VA 24084. The Geology of Virginia CD-ROM project was initiated with the goals of providing information about the geology of Virginia to earth science teachers, students, and citizens of the state in a way that is easy to access, practical for classroom use, and inexpensive. To meet these goals, we are creating a series of four interactive, multimedia CD-ROMs: *Introduction and Geologic Background*, *Coastal Plain*, *Piedmont and Blue Ridge*, and *Valley & Ridge and Appalachian Plateaus*. Each CD-ROM is accompanied by a Teacher's Guide with worksheets for students and answers for teachers. Each CD-ROM includes text, photographs, diagrams, animations, videos, music, sound clips, and slide shows. To create the CD-ROM, information was organized, screens were created and captured, links were created, slide shows were produced, and videos, sounds, and mouseovers were linked to the screens. This presentation features *CD-ROM 2:Coastal Plain*. A demonstration of the CD-ROM is provided in the presentation.

APPLICATION OF GIS TECHNOLOGY TO CIVIL WAR GEO-ARCHEOLOGY OF SALTVILLE, VA. Brendan T. Cox[1], Ryan C. Murley[1], B. Kuennecke[2], R. Whisonant[1], L. LeMay[2], & C. Boyd[3]. [1]Dept. of Geology, [2]Dept. of Geography, [3]Department of Sociology and Anthropology, Radford Univ. Saltville, Virginia has many historical aspects. The Civil War history is just one of these aspects. Radford University is part of a multidisciplinary project that involves locating undiscovered historical features. The focus of these investigations is the salt making process. This process leaves certain signatures that can be recognized by certain types of remote sensing. NASA's involvement in this project includes the use of the AVIRIS platform, which has never been applied to geo-archeology. A GIS database was needed to correlate the AVIRIS to other digital maps of the Saltville valley. This project focuses on the process and importance of this database. Digital maps of the geology and soils were produced and overlain on topographic maps as a foundation for this GIS database.

DESIGN AND DEVELOPMENT OF AN INTERACTIVE, MULTIMEDIA CD-ROM FOR TEACHING AND LEARNING OPTICAL MINERALOGY. William Smith, Mitch Bupp, & Parvinder S. Sethi, Dept. of Geology, Radford Univ., VA 24142. This paper presents results of an ongoing instructional technology project aimed at integrating the latest CD-ROM-based multimedia techniques into the GEOL-212 (Mineralogy) course at Radford University. The goal of this project was to obtain microphotographs and micro-videographs of a total of twenty-five common rock-forming minerals via a 35-mm SLR camera and a high-resolution micro-videocamera attached to a high-quality petrologic microscope and to digitize such photographs for creation of CD-ROM screens that can be used by students both in and outside of the classroom as an electronic study aid. This presentation will demonstrate some of the multimedia screens and the ease with which students can access microphotographs, micro-video clips and mineralogical information related to a particular mineral in thin section. The authors would like to thank the Office of the Vice-President for Academic Affairs for financial support. The authors would also like to thank the Mineralogy Class of Fall, 1999 for their input via a survey that was conducted prior to the design and initiation of the first phase of this project.

GRAIN SHAPE SIGNATURE DEVELOPMENT USING FOURIER SHAPE ANALYSIS: COMPARISON OF QUARTZ GRAINS IN NEW RIVER TERRACE DEPOSITS, RADFORD VIRGINIA. Josh C. Hickman[1], Kimball Knight[1] & Jill Alcorn[2], [1]Dept. of Geology, Radford Univ., [2]Dept. of Mathematics and Statistics, Radford Univ. Fourier Shape Analysis of sediment grain shapes provides new opportunities for river terrace deposit correlation and hydrologic studies. Replacing the tedious and often erroneous visual grain shape analysis techniques, the computer software SigmaScan Pro was modified to reproduce an exact value for each individual sample making the process numerically precise and expedient. Utilizing this method, samples were collected from sites at various terrace levels along the New River in the Radford, VA, area, and analyzed. Results of this process were then consolidated and graphed producing a terrace grain shape signature. Work is now underway to quantify these results by running the same set of twenty grains numerous times and discovering the variation due to favored orientations of grains when the Fourier Shape Analysis is run.

FORENSIC GEOLOGY: APPLICATIONS OF GEOLOGY TO CRIMINAL INVESTIGATIONS. Daniel S. Acker, Dept. of Geology and Environmental Science, James Madison Univ., Harrisonburg, VA 22807. The earliest applications of geology to criminal investigations are found in the 1887 fictional writings of Sir Arthur Conan Doyle. These writings provided the world with scientific ideas that, until that time, had only existed in the mind of the author. However, in 1904 the first of these imaginative theories began to take form, thus establishing the field of Forensic Geology. Today, virtually every law enforcement and regulatory agency collects earth materials for investigative and forensic purposes. However, validity of this forensic evidence is determined by the amount and quality of the data collected, and by the application of probability and statistics. Therefore, Forensic Geologists are required to utilize a myriad of technical and scientific laboratory procedures associated with their fields of expertise. These procedures, including stereo and petrographic microscopy, scanning electron microscopy, x-ray diffraction, and spectrophotometry, have contributed crucial scientific evidence necessary in establishing the guilt or innocence of many individuals. This research will examine these forensic applications of geology and why they have become a valuable aid in the apprehension and adjudication of criminal offenders.

THE INFLUENCE OF AGRICULTURE ON GROUNDWATER QUALITY: A HYDROGEOLOGICAL AND GEOCHEMICAL PERSPECTIVE. Janie B.W. Vinson, East Carolina Univ. This study was designed to examine how agriculture affects the surficial aquifer of the Pete Mitchell Swamp Drainage Basin in North Carolina. Groundwater movement in the surficial aquifer is from north to south with a seasonal water-table fluctuation of 4.5 feet (ft); the annual mean groundwater discharge is 9.01 inches for a given unit of area. Transmissivity [2452-290.2 ft^2/day (ft^2/d)], horizontal conductivity (181.9-20.92 ft/d), storativity (2.087×10^{-7}–9.031×10^{-6}), and specific yield (4.446×10^{-5}–1.781×10^{-3}) were calculated from a constant-rate aquifer test and slug tests. Water samples from the surficial aquifer in 1993 generally occurred in the calcium sulfate hydrogeochemical facies with lithology (quartz, plagioclase and potassium feldspar) having a minor impact on groundwater chemistry. However, samples along a flow path in an agricultural area of the basin had elevated sulfate, calcium, and nitrate concentrations relative to groundwater samples from nonagricultural sites. A potential source of these elevated concentrations is agricultural applications. Dissolution of solid fertilizers increases the concentration and variety of ions in groundwater. Concentrations of sulfur and nitrogen species from fertilizers may also change according to the redox state of the system.

ROCKFALL HAZARD INVENTORY ALONG THE CASCADES TRAIL, JEFFERSON NATIONAL FOREST, GILES COUNTY, VIRGINIA. Daniel R. Gilliam[1], Chester F. Watts[1], Paul Bartholomew[1], Kelly Burton[1] & Thomas K. Collins[2] , [1]Dept. of Geology, Radford Univ., [2]U.S.D.A.-Forest Service. In joint cooperation with the U.S. D.A.-Forest Service, the Department of Geology at Radford University has undertaken a study, still in progress, examining rockfall hazards at three sites along the Cascades Trail in Giles County, Virginia. The area lies within the Valley and Ridge province, in Orodovician and Silurian-aged rocks. Site 1 concerns a rockfall topple potential, dangerous in that the rock in question is used as a shelter during severe weather by hikers along the trail. Site 2 is the location of previous rockslides, and the remaining rock is examined for potential future failures. Site 3 is a cliff surrounding the waterfall itself, from which rocks occasionally fall and roll down toward Little Stony Creek, posing a threat to visitors and man-made structures below. The three sites are analyzed using stereonets for their structural integrity. The report which constitutes the outcome of the study will present a rockfall hazard analysis which can be used in developing remedial action plans, as well as to give recommendations and guidelines for future studies, and serve as a benchmark for monitoring future changes in the areas studied with respect to rockfall potential.

GEOMORPHOLOGY AND HYDROLOGY OF A MITIGATION WETLAND SITE, OCEANA RIDGE, VIRGINIA BEACH, VIRGINIA. Richard G. Whittecar, Dept. of Ocean, Earth, and Atmospheric Sciences, Old Dominion Univ., Norfolk, VA 23529 & Melanie A. Frisch, Virginia Dept. of Transportation, Suffolk, VA 23435. Abandoned sand mine pits along a relict barrier island in eastern Virginia Beach contain 3 ponds fed only by precipitation and groundwater. Well logs and nearby exposures suggest the surficial aquifer contains at least several meters of medium-to-coarse sand. Analyses of water table wells indicate groundwater passes through the ponds as it moves away from the ridge crest to small creeks nearby. Effective Monthly Recharge (W_{em}) calculations suggest that the pond levels respond to major recharge events with a two-to-three month lag. Plans call for the creation of new wetland areas around and between two ponds that have nearly identical water level histories. According to the W_{em} analysis, from 1945 to 1995 the elevations of this new wetland surface were inundated for at least half of the growing season during more than 70% of the years of record. Thus this proposed wetland site should have sufficient hydrology from groundwater alone to maintain a viable wetland.

NOISE REDUCTION FOR IMPROVED MAGNETOTELLURIC SOUNDING. Michael Wallace & John Wallace, Hampden-Sydney College and Casting Analysis Corporation. Magnetotelluric sounding is a geophysical surveying method for finding conducting layers such as ore bodies and aquifers. To use this method, one must be able to sample and calculate small low frequency electric and magnetic field values simultaneously. In areas with power grids, filtering, data capturing and source analysis must all be taken into account. Adjusting the design of filtering electronics in a multi-channel analyzer and making the sensors portable diminished the noise sampled where measurements of electric and magnetic fields could be measured accurately. Now only a small amount of data is needed to measure the conductivity structure of the earth. With the reduction in ambient noise geomagnetic pulsations can be isolated over a spectral range. The initial phase of development for the system is complete. The next phases are creating a user interface and reducing the design to a large FPGA for a more compact instrument and implementing the different analysis models within the system for active and passive sensing.

SAND FRACTION STUDIES OF THE NORTH RIVER FLOODPLAIN, ROCKINGHAM COUNTY, VIRGINIA. Michele Butczynski and W. C. Sherwood, Dept. of Geology and Environmental Science, James Madison Univ, Harrisonburg, VA 22807. Floodplain sediments along the North and Dry Rivers in Rockingham County, Virginia are composed mainly of medium to fine sands weathered from the clastic rocks in the ridges west of the Shenandoah Valley. Sediment samples were collected from ten specified locations along the rivers starting upstream at the junction of Routes 613 and 732 and ending downstream off of Route 659. The sand fraction of each sample was analyzed in the laboratory using the phi gradation method. Based on statistical treatment of the results, several trends were noted: 1) The -230 fraction showed a general increase, and the mean sand size a general decrease from upstream to downstream; 2) standard deviation decreased downstream indicating an increase in grain sorting; 3) skewness values were positive at the first three stations but turned increasingly negative downstream; 4) compared to the relatively large positive skewness values reported for stream sands in the literature, all skewness values in this study were small, ranging from +0.27 to -0.48. Finally kurtosis, a measure of peakedness of the size distribution curve, increased downstream reflecting the increase in sorting noted above.

SLOPE STABILITY ANALYSIS RELATED TO ROAD IMPROVEMENT AND WIDENING OF ROUTE 705 IN MONTGOMERY COUNTY, VIRGINIA. Matthew L. Thornton & Chester F. Watts, Dept. of Geol., Radford University, Radford, Va 24142. Route 705 is an all weather surface road that passes through numerous road cuts that vary in lithology and orientation. The focus of this research applies to the Price Formation road cut in section 6 within the Virginia Department of Transportation (VDOT) modification designs (2000). The stereonet analysis performed on this road cut shows Markland's Tests in relation to plane, toppling and wedge failures. In site 1, part 1 plane failures are caused by steep joints and some faults, topple failures exist, and there are no current wedge failures. In site 1, part 2 plane failures are caused by steep joints and faults, topple failure exists, and there is one wedge failure that does not fall in the super critical zone. VDOT modification designs cut the current slope to forty-five degrees and sustain the current road trend at this site. Based on VDOT modification designs: site 1, part 1 will show no plane failures, no wedge failures, and no toppling failures; site 1, part 2 will show minimal plane failures, no wedge failures, and no toppling failures. It is recommended that the current slope could be remediated to forty-five degrees with minimal failures after modification.

MORPHOLOGY AND STRATIGRAPHY OF CAROLINA BAYS IN CHESTERFIELD COUNTY, VIRGINIA Sara E. Spradlin & Gerald H. Johnson, The College of William and Mary. Carolina Bays, which occur only on the Atlantic Coastal Plain, are elliptical to irregular depressions with single, multiple, or no sand rim. In Chesterfield County, Virginia over 165 Carolina Bays, most previously undescribed, are found on undissected uplands of the Middle and Upper Coastal Plain. Approximately 50 bays occur at an elevation of 115 to 100 m on the Midlothian Uplands, and the remainder on the Richmond Plain at 70 to 65 m. The Carolina Bays in Chesterfield County vary in shape from elliptical to irregular, in long axis length from 75 to 800 m, from single to compound, in orientation, and in degree of rim development. This study focused on Salisbury Bay on the Midlothian Uplands, and Baugh Bay on the Richmond Plain. Sediments in both bays were texturally and mineralologically similar to each other and to the parent material on which they formed. Salisbury Bay was slightly coarser and contained more varieties of quartz than Baugh Bay. Conditions necessary for Carolina Bay formation are: a relatively flat land surface, a denuded landscape, a prevailing wind, and a high water table. Of the many hypotheses that have been proposed to explain the origin of Carolina Bays only Thom's 1970 wind and water hypothesis meets most of these criteria.

Materials Science

INVESTIGATION OF THE ATMOSPHERIC CORROSION INSIDE THE LULING BRIDGE, NEW ORLEANS. Desmond C. Cook & Ann C. Van Orden (dec.), Old Dominion University, Norfolk, VA 23529. The corrosion products formed on the interior weathering steel box-sections of vertical support piers of the Luling Bridge in Louisiana, have been analyzed and compared with those formed on atmospherically exposed coupons for which the protective oxide layer is very adherent and stable. It was determined that very high fractions of large particle maghemite form in the hot and humid conditions inside the boxes. The high time-of-wetness also significantly reduces the fraction of nano-phase goethite which forms and this, along with the presence of maghemite, most likely prevents the formation of the adherent protective corrosion coating needed to reduce the long term corrosion of weathering steel. Spectroscopic analysis showed that the corrosion product composition varied with height of the box-sections in the pier, most likely due to the different local environmental conditions within each enclosed box. In general the corrosion products contained about 30% maghemite and 60% goethite which is very different to the composition found on well protected weathering steel and more like that found on carbon steel exposed in a mild marine environment. The large amount of sheet-like rust within the box-sections, supports the argument that insufficient wet-dry cycling conditions are available for proper protective coating formation.

THE INVESTIGATION OF CREVICE CORROSION USING COMPUTATIONAL MODELING. Jason S. Lee & Robert G. Kelly, Dept. of Mat. Sci. & Eng., Univ. of Virginia, Charlottesville, VA 22904. A two-dimensional computational model for mass transport in occluded regions has been developed at The Univ. of Virginia. The model maps the spatio-temporal chemical and potential fields within a crevice in two dimensions, taking into account diffusion, migration, and generation of species. One key characteristic of the model is its ability to handle two spatial dimensions. Crevice corrosion of nickel in 1N H_2SO_4 will be one of the systems that will be studied and presented. The results from an array of boundary conditions (*e.g.*, gap, potential, critical current density, anodic polarization behavior) will also be presented, along with parameters predicted from the computational model (*e.g.*, position of maximum attack).

PHOTOELECTROCHEMICAL ETCHING OF III-V COMPOUND SEMICONDUCTORS. Todd M. Harrell & Wm. Christopher Hughes, Dept. of Physics, James Madison University, Harrisonburg, VA 22801. The etching of the III-V compound semiconductor GaAs by photo-assisted electrochemical techniques has been studied. Samples of GaAs were patterned using conventional photolithography and then placed in KOH-containing solutions. While weak etching can be observed even without external biasing, the etch rate is dramatically increased by anodically biasing the sample. In addition, the etch rate was increased by the addition of hydrogen peroxide to the bath. Steep side walls were observed on mesa-like features to a depth of 2 or 3 microns under uniform illumination with ambient room light. Beyond this, the side walls tapered away due to shadowing effects. Potential mechanisms for the etching process and extension of these experiments to GaN will also be discussed.

LASER SPECTROSCOPY OF Cr^{2+} AND Co^{2+} DOPED CADMIUM CHALCOGENIDES. A. G. Bluiett, U. Hömmerich, J. T. Seo, M. Turner, S. B. Trivedi, S. W. Kutcher, R. J. Chen, C. C. Wang & H. Zong, Research Center for Optical Physics, Hampton University, Hampton, VA 23668 & Brimrose Corporation of America, 5020 Campbell Blvd., Baltimore MA 21236. Mid-infrared (MIR) lasers which are broadly tunable and operational at room temperatures are of interest for various applications. Transition metal (TM) doped solids is a favorable candidate for broadly tunable lasers, due to their vibronic operation. Further, Cr and Co doped II-IV semiconductors have shown broad absorption and emission bands in the MIR. At Hampton University, Cr and Co doped $Cd_{0.55}Mn_{0.45}$ Te are currently being analyzed for their potential for MIR lasers. These TM shows a strong preference for the tetrahedral sites in $Cd_{0.55}Mn_{0.45}Te$, which is conducive to stronger transition strengths, due to the host's odd-parity crystal field. Concurrently, Cr and Co doped $Cd_{0.55}Mn_{0.45}Te$ possess broad absorption bands at 1900nm with corresponding transition from the ^5E to $^5T_2$ quintet spin states and $^4A_2$ and $^4T_1$ quadruplet spin states, respectively. Emission bands for Cr and Co doped $Cd_{0.55}Mn_{0.45}Te$ are red shifted to 2500nm (FWHM:720nm) and 3700nm (FWHM:550nm).

MEASUREMENT OF THE BREAKDOWN AND REPASSIVATION POTENTIALS OF TITANIUM GRADE 5 AND TITANIUM GRADE 2 IN 3.5% NaCl SOLUTION. Mark W. Pearcy & Desmond C. Cook, Dept. of Physics, Old Dominion University, Norfolk, Va. 23529. The Repassivating and Breakdown potentials for grade 5 titanium (Ti-6Al-4V) and for grade 5 coupled with grade 2 titanium in 3.5% NaCl solution at varying pH were measured by Electrochemical Impedance Spectroscopy (EIS) using the cyclic polarization method. Determining these potentials established pitting corrosion behavior of the metals. The repassivation and breakdown potentials for grade 5 titanium were much lower than those of grade 2 titanium. The pH of the electrolyte had no significant effect on either the repassivation or breakdown potentials of grade 5 titanium, but did appear to have an effect on the corrosion rate of the metal. Coupling of the metals resulted in no significant change in either the repassivation or breakdown potentials for grade 5 titanium. Coupling the metals did result in an unexpected increase in the metal's corrosion rate below the repassivation potential for grade 5 titanium. It appears that the coupling of the metals has a more pronounced effect on how well the protective oxide layer protects the metal from corroding than does the pH of the electrolyte.

A COMPARISON OF THE LOCALIZED COATING FAILURE OF AA1100-H14 AND AA2024-T3. Jackie M. Williams, Oliver Schneider, & Robert G. Kelly, Center for Electrochemical Science and Engineering, Department of Materials Science and Engineering, University of Virginia, Charlottesville, VA 22904. To successfully improve coating systems used for corrosion protection on aircraft, a detailed understanding of the mechanism of coating failure leading to blister formation and subsequent localized corrosion is necessary. Coating blisters grown on AA2024-T3, a high-copper content aluminum alloy (4.5% Cu) used extensively in aircraft construction, are characterized by a red color due to replated Cu. The effects of the replated Cu on blister formation and growth and the chemistry inside these defects were studied by comparing blister behavior on AA2024 to that on AA1100-H14, a low-copper content aluminum alloy (0.12% Cu). Coated panels of AA1100 were exposed to corrosive salt solutions known to cause blister growth on AA2024. Both global electrochemical measurements and a combination of local chemical and electrochemical analyses inside individual blisters provided a means of measuring and determining the effects of replated Cu on the corrosion and chemistry inside these defects.

ELECTROCHEMICALDEPOSITION OF METALS ON SEMICONDUCTORS. Sharon E. Koh & Wm. Christopher Hughes, Dept. of Physics, James Madison University, Harrisonburg, VA 22801. Electrochemical techniques have been examined for the metallization of III-V compound semiconductors in conjunction with soft-lithographic methods. In particular, Zn, Cu, and Ni have been electrodeposited on GaAs and ohmic contacts consisting of Cu with a Ni barrier layer have been formed. Depositions were performed using specimens patterned by conventional photolithographic techniques to optimize the electrodeposition process. As an alternative to conventional photolithography, soft-lithographic methods utilizing self-assembling monolayers (SAMs) of 1-hexadecanethiol (HDT), 16-mercaptohexadecanoic acid (MHA), and octadecylphosphonic acid (OPA) are being examined. Contact angle measurements have been taken to determine the usefulness of each of these possible SAM-forming molecules on GaAs and GaN. Dramatic changes in the wettability were observed for OPA-coated (100) GaAs. A similar, though less dramatic effect was observed for (0001) GaN. Mixed results were observed for the formation sulfur-terminated HDT and MHA monolayers on both GaAs and GaN. Possible explanations of these results and the use of these monolayers as ultra thin deposition and etch masks will be discussed.

SYNTHETIC CHROMIUM SUBSTITUTED GOETHITE. Rama Balasubramanian, D. C. Cook, Dept. of Physics, Old Dominion Univ., Norfolk, VA 23529 & M. Yamashita, Dept. of Mechanical Engineering, Himeji Institute of Technology, Japan. Chromium substituted goethite is most commonly found in the corrosion products of weathering steel. It has been observed that the formation of nano-sized goethite particles is related to the presence of chromium in the weathering steel. To understand corrosion protection properties of nano-phased goethite in a coating, synthetic chromium substituted goethite have been investigated. Chromium substituted goethite, $-Fe_{(1-x)}Cr_{(x)}OOH$ (where x=0,1.44,3, 7,10.14 wt.%) were synthetically produced. The magnetic and crystalline properties of the samples were studied using Transmission Mössbauer spectroscopy and x-ray diffraction. As the chromium concentration increased from 0 to 10 wt.%, the particle size decreased rapidly from 200 nm to 10 nm. No appreciable lattice strain was observed. From Mössbauer measurements, the blocking temperature was determined to be 320 K for 10.14 wt .% chromium substituted goethite. The anisotropy constant for the 10.14 wt. % substituted Cr was found to be 4.23×10^3 J/m^3. For both pure and chromium substituted goethite, the asymmetry in the doublet of Mössbauer spectrum recorded between 300 and 400 K was attributed to two contributions, one from the bulk and the other from the surface of the material.

THE INFLUENCE OF HARD SECOND PHASES ON THE FRICTION AND WEAR BEHAVIOR OF POLYMER MATRIX COMPOSITES USED IN BRAKE LINING APPLICATIONS. Jennifer A Wilcox & Dana Elzey, Dept. of Materials Science, The University of Virginia, Charlottesville, Va, 22904. Hard second phases in polymer matrix composites may play several distinct roles during sliding wear, including stiffening/strengthening of the polymer matrix, abrasive cleaning of the countersurface, and reducing the overall composite wear rate. However, debris particles generated during wear may lead to accelerated wear rates by acting as an abrasive at the sliding wear interface. Improved fundamental understanding of the multi-functional character of hard second phases is needed in order to refine, improve, or replace existing friction and wear models. Our investigation emphasizes the influence on the friction material's performance of the intrinsic properties of second phases considered hard relative to the matrix. Model composites will be made consisting of a selected (phenolic-based) polymer matrix combined with one or two second phases (SiC, Al_2O_3, SiO_2) followed by sliding wear testing. A sliding friction and wear tester was designed and built for this purpose which provides for maximum control of experimental variables such as applied load and sliding velocity. This study is funded by Carlisle Motion Control Industries, Inc.

OPITICAL AND LASER PROPERTIES OF A MID-INFRARED GAIN MEDIUM CR2+ DOPED $Cd_{0.55}Mn_{0.45}Te$. M.C. Turner[1], U. Hšmmerich[1], J.T. Seo[1], A. Bluiett[1], S.B. Trivedi[2], H. Zong[2], S.W. Kutcher[2], C.C. Wang[2] & R.J. Chen[2], [1]Department of Physics, Hampton University, Hampton, VA 23668 and [2]Brimrose Corporation of America, 5020 Campbell Blvd., Baltimore, MD 21236. Recently there has been much interest in developing mid-infrared lasers. These lasers have many applications including laser remote sensing, medicine, and spectroscopy. Using a Cr,Tm,Ho :YAG laser, operating at 2.09 m, initial laser studies of Chromium-doped $Cd_{0.55}Mn_{0.45}Te$ were performed. Room temperature lasing with tunable coverage from 2.17 m to 3.01 m is reported. The lasing medium has been identified to be Cr^{2+}. Laser action with slope efficiencies as high as 44% were obtained. Chromium- doped $Cd_{0.55}Mn_{0.45}Te$ was grown by a modified Bridgman technique using a three heating-zone furnace. This mid-infrared optical material can be commercially produced with high mechanical and optical quality. Details on the optical and laser properties of the material will be presented at the conference.

PHASE EQUILIBRIA OF NANOPARTICLES. C. Tom Schamp & William A. Jesser, Dept. Of Materials Science and Engineering, University of Virginia, Charlottesville, VA 22903. It has been found that as particle size gets small, the properties begin to deviate from that of bulk. To study this effect, nanoparticles with diameters of less that 50nm are used. This effect is a result of the large surface to volume ratio ($\frac{A}{V} = \frac{3}{y}$, assuming spherical particles). The particles are formed by co-vapor deposition onto heated amorphous carbon coated TEM grids in an ultra-high-vacuum system. Energy Dispersive X-ray Spectroscopy (EDXS), Nano-Beam Diffraction (NBD), and bright-field TEM imaging are used to study alloy BiSn nanoparticles. Data indicating that the two-phase size-dependent room-temperature phase boundary pinches off at about 10nm in diameter is shown. The recent data of the sub-eutectic size dependent phase diagram for the BiSn system is shown. This data is plotted with the previously published data of the pro-eutectic portion of the size dependent phase diagram.

Medical Sciences

THE EFFECTS OF IL-1 AND IL-6 ON AORTIC SMOOTH MUSCLE CELL MIGRATION AND GROWTH. Andrea Rossi & Kathryn Loesser. Dept. of Biol., Mary Washington Col., Fredericksburg, VA 22401. Atherosclerosis involves the recruitment of many cells and factors, including smooth muscle cells. Previous research has suggested that interleukins play a role in the migration and proliferation of smooth muscle cells during plaque formation. The hypothesis tested in this experiment was that IL-1 and IL-6, introduced separately, would increase smooth muscle cell migration. A Boyden migration chamber was used to determine that in all cases, the interleukins increased cell migration, as compared with the control. Il-6, at a concentration of 0.4 ng/ml, had the greatest impact on migration with a 200% increase in migration from controls in each trial. Migration of cells in presence of Il-6 at 0.4ng/ml and Il-1 at 100ng/ml both showed statistically significant differences from the control, and Il-6 was statistically different from Il-1 at 100ng/ml and Il-6 at 0.2ng/ml. When compared with the control, Il-6 0.4ng/ml increased migration by an average of 270 +/- 33.3 % and Il-1 100ng/ml had a mean increase in migrated cells, as compared with the control, of 49.3 +/- 21.2 %. Further studies investigating the role of interleukins on smooth muscle cell actions during atherosclerotic lesion formation would be helpful in determining the specific role of Il-1 and Il-6 in the atherosclerotic process.

OPIOID RECEPTOR LEVELS IN 9-THC- AND MORPHINE-TOLERANT MICE. Diana L. Cichewicz and Sandra P. Welch, Dept. of Pharmacology, Virginia Commonwealth Univ., Richmond, Va. 23298. We have shown that after short-term administration of a combination of low doses of THC and morphine p.o. to mice, there is no behavioral tolerance to the opioid. If we have been able to prevent tolerance to morphine by co-administering THC, then we should not see the manifestation of that tolerance at the receptor level. We evaluated the levels of opioid (mu, kappa, delta) and cannabinoid (CB1) receptors in mouse models of short-term exposure to THC, morphine, or both drugs in combination. Tissue samples (midbrains and spinal cords) were collected from mice treated for 5-7 days. Western blot analysis revealed that mu receptor levels are significantly decreased in morphine-tolerant mouse midbrains, confirming previous laboratory results. We also saw that in animals treated with a combination of low doses of THC and morphine for several days, there was no change in opioid receptor levels in the midbrain. This indicates that our prevention of behavioral tolerance to morphine is substantiated by a lack of opioid receptor down-regulation. Further studies with spinal cord tissue are in progress to elucidate receptor levels in tolerant and non-tolerant mice.

PROPERTIES OF Fe-SUPEROXIDE DISMUTASE FROM PORPHYRIMONAS ASACCHAROLYTICA. E. A. Clark & E. M. Gregory, Dept. of Biochemistry, Virginia Tech, Blacksburg, VA. *Porphyromonas assacharolytica* is a gram-negative anaerobe frequently isolated from infected bite wounds. The anaerobe synthesized the antioxidant enzyme superoxide dismutase (SOD) which catalyzes the disproportion of superoxide radical. *Porphyromonas assacharolytica* SOD was isolated to electrophoretic homogeneity. The isolated protein had a specific activity of 2100 Units/mg. The SOD eluted from calibrated Sephadex G-100 as a 40kD protein and as a single 20kD protein in SDS-PAGE. The *Porphyromonas assacharolytica* SOD is therefore a dimer of equally sized subunits. The SOD was instantaneously inhibited by low concentrations of sodium azide and was 50% inactivated after 10 minutes incubation H_2O_2, characteristic of iron-containing SOD. This indirect evidence is consistent with synthesis of an iron-containing SOD in *Porphyromonas assacharolytica*. (Supported in part by Va. Tech Biological Sciences Initiative. A portion of this work was completed by EAC as a Fralin Biotechnology Summer Fellow)

PHYTOESTROGENS AS CALCIUM CHANNEL MODULATORS IN THROMBIN-ACTIVATED HUMAN PLATELETS. Y.Dobrydneva[1], R.L.Williams[1] & P.F.Blackmore[2]. [1]Department of Chemistry and Biochemistry, Old Dominion University, Norfolk, VA 23529 and [2]Eastern Virginia Medical School, Norfolk, VA 23501. Previously we have shown that phytoestrogenic compound *trans*-resveratrol inhibits platelet function by inhibiting calcium influx into activated platelets. In the present study, using the method of radiometric dyes for monitoring free intracellular calcium concentration it has been shown that most abundant dietary phytoestrogens, namely genistein and daidzein, inhibit calcium influx into thrombin-stimulated human platelets, thus preventing aggregation. These phytoestrogens are also inhibiting thapsigargin-induced calcium influx and basal activity of calcium channels, and genistein glucoside is also active suggesting that phytoestrogens are directly modifying the activity of SOCC (store-operated calcium channels). IC_{50} for genistein and daidzein to inhibit platelet function is in low micromolar range, which can be physiologically achieved in plasma by moderate consumption of phytoestrogen-rich foods. Therefore these compounds may serve as natural blood thinners. (This work was supported by grant from Jeffress Memorial Trust).

CHARACTERIZATION OF *SPHINGOMONAS CAPSULATA* SUPEROXIDE DISMUTASE. S. J. Free and E. M. Gregory, Dept. of Biochemistry, Virginia Tech, Blacksburg, VA. Superoxide dismutase (SOD), a metalloenzyme, was isolated 176 fold from *Sphingomonas capsulata* to a specific activity of about 2,500 units/mg. Native polyacrylamide gels stained for superoxide dismutase activity revealed a single band of activity in cell extracts (14.4 units/ mg) or as isolated. Under the growth conditions imposed, *Sphingomonas capsulata* synthesizes only one type of SOD. The molecular weight of the SOD was 40,000 based on chromatography through calibrated Sephadex G-100. Sodium azide (0.5 mM) inhibited SOD activity by 50%. SOD was also rapidly inactivated upon incubation with H_2O_2. One hour incubation of the enzyme with hydrogen peroxide (2mM) resulted in 90% inactivation. SOD rapidly lost activity at pH <4 but remained stable up to pH 9. Modest inactivation was observed at pH > 9. These data are consistent with synthesis of a single Fe-containing SOD in *Sphingomonas capsulata.* (Supported in part by Va. Tech. Biological Sciences Initiative. A portion of this work was completed by SJF as a Fralin Biotechnology Summer Fellow)

MATHEMATICAL MODEL OF THE GROWTH AND TREATMENT OF *IN VITRO* CARCINOMA CELL CULTURES - EFFECTS OF THE NOVEL MICROTUBULE PERTURBING AGENT

CURACIN A. Frank P. Kozusko[1], Billy W. Day[2] & John C. Panetta[3], [1]Department of Mathematics, Hampton University, Hampton, Virginia 23668, [2]University of Pittsburgh Cancer Institute, Pittsburgh, Pennsylvania 15238 and [3]St. Jude Children's Research Hospital, Memphis, Tennessee 38105. A mathematical model of cancer cell growth and response to treatment with the antimitotic drug curacin A is presented. Rate parameters for the untreated growth of A2780 ovarian and MCF-7/LY2 breast cancer cell lines are determined from *in vitro* growth studies. Subsequent growth studies with 2.5nM, 25nM and 50nM doses of curacin A are used to determine the effects of the drug on the cell cycle. The model's system of ordinary differential equations yields an approximate analytical solution which predicts the minimum drug dose necessary to prevent growth. The model shows that cell growth is arrested when the apoptotic rate is greater than the mitosis rate and that the S-phase transition rate acts to amplify the effect. The drug is rapidly absorbed into the cells of both cell lines causing an increase in the S-phase transition and a decrease in the M-phase transition. The rate of apoptosis remains virtually constant for MCF-7/LY2 while that of A2780 increases.

AGE-RELATED PRODUCTION OF -CRYSTALLIN AND UBIQUITIN IN RAT MYOCARDIUM. Merissa J. Lantz & Kathryn E. Loesser, Mary Washington College. Young animals can tolerate high fevers, a form of major stress, for long periods of time, where as adult animals cannot. Research shows that a class of proteins, heat shock proteins (hsp) are expressed in animals after periods of stress. They have been implicated in protein chaperoning, protein protection and protein folding. This research focused on two hsp. Ubiquitin has a small molecular weight and is associated with the break down of proteins. Alpha B-crystallin, another small molecular weight hsp, has been shown to have a chaperoning function to prevent aggregation and help with protein folding. The goal of this research was to determine whether juvenile animals constitutively express heat shock proteins. Juvenile and adult rats were heat shocked, allowed to recover, and their hearts were analyzed for the presence of hsp. The heart samples were homogenized; the protein concentrations determined, polyacrylamide gel electrophoresis (PAGE) was performed. Using Western Blot trials and monoclonal anti-ubiquitin and anti- B-crystallin protein presence was detected. The results showed that juvenile rats did have constitutive expression of the proteins. The adult rats only had expression of the proteins after being heat shocked. More studies need to be done to further prove these findings.

TUMOR-INDUCED MACROPHAGE DYSFUNCTION IS MEDIATED VIA DYSREGULATION OF CD40L EXPRESSION. Ryan S. Martins[1], David W. Mullins[2], & Klaus D. Elgert[1], [1]Dept. of Biol., Virginia Tech, Blacksburg, VA 24061 and [2]Carter Immunology Center, Univ. of Virginia, Charlottesville, VA 22901. Tumors evade immune responses, in part, through the release of suppressor signals that dysregulate host effector cell function. We demonstrate that tumor growth suppresses immune activation by inhibiting T cell CD40L expression, disrupting macrophage (M) activation pathways, which impairs production of immunostimulatory mediators, interleukin (IL)-12 and IL-18 by tumor-bearing host (TBH) M s. IL-12 and IL-18 production by normal M s is lowered upon incubation with tumor-derived supernatants, demonstrating the role of tumor-derived factors. Disruption of CD40L expression, via dysregulation of IL-12 and IL-18 production, impedes T cell interferon (IFN)- , which in turn exacerbates M dysfunction. IFN- is essential for expression of IFN consensus sequence binding protein (ICSBP); TBH M s demonstrated lowered expression of ICSBP, which regulates CD40L, IL-12 and IL-18 expression through the IFN-stimulated response element (ISRE). Thus, dysregulated CD40L expression significantly contributes to tumor-induced immune dysfunction. (This study was supported, in part, by The Virginia Academy of Science.)

ADOPTIVE TRANSFER OF LYMPHOCYTES FROM TYROSINASE-DEFICIENT ANIMALS MEDIATES AUTOIMMUNE VITILIGO IN HLA-A*0201-TRANSGENIC MICE. D.W. Mullins, T.A. Colella, T.N.J. Bullock, C.J. Luckey & V.H. Engelhard, Carter Immunology Center, University of Virginia, Charlottesville, VA 22908. Antigens recognized by melanoma-reactive CTL may originate from melanocyte differentiation proteins (MDPs), including the pigmentation enzyme tyrosinase. We used a murine model to test the impact of tyrosinase expression on immune effector populations. Following adoptive transfer of CTL specific for the HLA-A*0201-restricted tyrosinase epitope (FMDGTMSQV), transgenic mice expressing the HLA-A*0201 molecule developed vitiligo, consistent with CTL-mediated destruction of melanocytes. Naïve splenocytes from HLA-A*0201$^+$ mice with a radiation-induced deletion of the tyrosinase gene also induced vitiligo on adoptive transfer, demonstrating that tyrosinase-derived antigens are expressed in an immunogenic context. These results suggest that an active self-tolerance mechanism may limit the development of vitiligo under normal circumstances. Collectively, these data demonstrate that CTL-based adoptive transfer therapies directed against tyrosinase can overcome peripheral tolerance and induce melanocyte destruction. As vitiligo has being associated with spontaneous melanoma regression, these data suggest that MDPs are useful targets for immunologic intervention in melanoma patients.

REVERSAL OF MORPHINE TOLERANCE WITH THE PKA INHIBITOR, KT5720. Alicia A. Robinson & Sandra P. Welch, Dept. of Pharmacology & Toxicology, Virginia Commonwealth University, Richmond, VA 23298. Previous work in our laboratory demonstrates that the PKA inhibitor, KT5720, can reverse tolerance to morphine. We now report the time-course administration of KT5720 reversal of morphine tolerance. Male ICR mice were implanted with either a placebo pellet or 75mg morphine pellet. The mice were subsequently injected twice per day with morphine (20 mg/kg, s.c.). Tolerance was induced in the mice as determined by a shift in the ED50 for morphine from 2.1 mg/kg (1.3-3.6) to 18.3 mg/kg (13.5-24.7) as determined using the tail-flick test. The acute administration of DMSO vehicle or KT5720 (1.3 microgram/mouse, i.c.v.) did not alter the ED50 for morphine in placebo-pelleted mice. However, the administration of KT5720 (i.c.v.) simultaneous with a morphine challenge dose s.c., in morphine-tolerant mice, reversed tolerance observed in such mice. The ED50 for morphine-tolerant mice was shifted significantly to the left (ED50 = 5.8 mg/kg [4.5-7.4]) and did not differ for mice that were placebo-pelleted and not morphine-tolerant (ED50 = 3.5 mg/kg [1.8-6.7]). These data confirm that KT5720 reverses tolerance, however, additional data suggest the reversal is only transient. Work supported by NIDA grants KO2DA00186 & DA05274 .

Natural History and Biodiversity

SAMPLING TECHNIQUES FOR TERRESTRIAL SALAMANDERS. Carola A. Haas[1], Douglas N. Harpole[2], Shannon M. Knapp[3] & Donald G. Mackler[1]. [1]Department of Fisheries and Wildlife Sciences, Virginia Tech., Blacksburg, VA 24061 [2](current affiliation) Virginia Cooperative Extension Service, [3](current affiliation) US Fish and Wildlife Service. Salamanders are difficult to observe and much information can be obtained only by capturing and marking animals. We discuss 3 capture methods (night-time area constrained searches, day-time time constrained searches, and coverboards). Night searches appear to give the least biased estimates of species, age, and sex classes present in the population. There are few reports on successful marking techniques for salamanders. As others have found, we had good success with toe-clipping for a study of short duration, but this technique is difficult on salamanders with very small toes. The most promising techniques appear to be injected fluorescent pigments (challenge is placing pigments where they can be seen on dark-bodied salamanders) which work well on small fish and pit tags (challenge is placement in a small salamander) which are retained by salamanders when incisions are closed with surgical glue. Work developing and comparing capture and marking techniques is essential to our ability to answer questions about behavior, ecology, and conservation of this important but little studied group.

ANT DEFENSIVE BEHAVIORS IN RESPONSE TO ANTING BY SONGBIRDS. Hannah C. Revis,

Old Dominion University, Norfolk, VA, 23529. Anting behavior is defined as the application of ants, held in the bill of a songbird, to it's own plumage. The defensive reaction, relative to songbird anting behavior, of five genera in subfamilies Myrmicinae and Formicinae was examined. Study hypothesizes were: 1.) ant pair trials would produce similar ant responses, 2.) a significant effect would exist between temperature/humidity upon ant responses. Ant genera were chosen based upon their average size and general defensive mechanism (mechanical vs. chemical). Ant paired trials consisting of two trays, each holding 20 ants, were conducted at the Virginia Living Museum Songbird Aviary, Newport News, VA. Ant defensive reactions were identified as active running or a group clumping response. Alarm pheromones emitted by ants under duress have low molecular weights and low specificity. This allows different ant species to respond to a perceived danger. Commonly perceived alarm pheromones suggest a similar response between ant pair trials would exist. While a significant difference did exist between the total response of the five genera, no significant difference existed between paired trials (Kruskal-Wallis test, $p=0.032$, & $p=0.684$ respectively). A two-factor ANOVA of temperature & humidity on ant response found no significant difference ($p=0.1654$).

ANTENNAE OF DIFFERENT TERMITE CASTES COMPARED USING LIGHT AND SCANNING ELECTRON MICROSCOPY. John Di Cicco, Keith Carson & Deborah Waller, Old Dominion University, Norfolk, VA, 23529. Termites perceive the environment through the sensillae on their antennae via chemo- and mechanoreception. Food, nestmates and enemies are all sensed through the antennae. Termite workers and soldiers have different functions in the colony and we hypothesized that the morphology of their antennae would reflect these differences. We compared the antennae of the Eastern Subterranean Termite, *Reticulitermes flavipes* (Rhinotermitidae, workers and soldiers using light and scanning electron microscopy. Termites from two colonies (five workers and five soldiers per colony) were collected from southeastern Virginia and examined for number of antennal articles, terminal article length, total length of the antenna and scape length. Worker and soldier antennae differed significantly in number of antennal articles and terminal article length, but they did not differ in total length of the antenna or scape length. Article shape differed between workers and soldiers; articles on soldier antennae appeared to have a neck while those of workers did not. Antennae of both workers and soldiers had circular patterns of setae on both the scape and the pedicel.

COMPARISON OF SPAWNING AND NON-SPAWNING SUBSTRATES IN NESTS OF SPECIES OF *EXOGLOSSUM* AND *NOCOMIS*. E. G. Maurakis[1&2] & T. D. Green[1], [1]Science Museum of VA, Richmond, VA 23220 and [2]Univ. of Richmond, VA 23173. Percent composition of pebble size classes from spawning and non-spawning substrates of nests were used to test the hypothesis that distribution of pebble sizes is random in nests of *Exoglossum laurae*, *Exoglossum maxillingua*, *Nocomis leptocephalus*, *Nocomis micropogon*, *Nocomis platyrhynchus* and *Nocomis raneyi* in Virginia. In all species, males selected 6.0 mm pebbles for spawning areas. Males of *N. micropogon*, *N. platyrhynchus*, and *N. raneyi* also selected 11.3 mm pebbles for spawning areas. Male *Exoglossum* and *Nocomis* expend significant amounts of time reorganizing substrate material of nests before and during spawning, resulting in relatively uniform sizes of substrate material in spawning areas. We propose that selection of 6.0 and 11.3 mm size classes for spawning areas is related to spawning behaviors and enhancement of egg and larval survival. Sizes larger than 11.3 mm interfere with spawning behaviors, and sizes smaller than 6.0 mm form a compacted substrate, which can crush eggs and larvae, or impede water flow and aeration of eggs and larvae. This study was funded in part by the Science Museum of VA, the Univ. of Richmond and the VA Academy of Science.

A KARST RESOURCE INVENTORY OF THE GEORGE WASHINGTON AND JEFFERSON

NATIONAL FORESTS. Terri Brown[1] & Dawn Kirk[2], [1]VA Natural Heritage Program and [2]George Washington & Jefferson National Forests. The George Washington and Jefferson National Forests (GW&JNF) stretch across nearly 1.8 million acres of the central and southern Appalachians in western Virginia and eastern West Virginia. Approximately 90 caves are documented on the Forest, although the exact locations, dimensions, and natural heritage value of many of these caves is not currently known. Important karst resources occur along the perimeter of the GW&JNF on private land, and could be potentially affected by forest management activities. The Forest Ecology Group determined that a detailed inventory of the natural heritage value of the caves is essential to the proper management and protection of karst resources both within and beyond the Forest boundary. The first phase of the inventory focuses on stygobitic fauna in the cave environments. A volunteer group of cavers formed the Karst Resource Inventory Team, and were trained to document their observations and correctly collect voucher specimens of stygobitic fauna from cave stream, epikarst, and phreatic habitats. The data will be used to enhance the management and protection of karst resources, and will serve as the basis for prioritizing the caves for "significant" status under the Federal Cave Protection Act (FCPA).

BIODIVERSITY OF GROUND BEETLES (CARABIDAE) IN NATURAL AND CREATED WETLANDS. Allyson R. Beckman & Deborah Waller, Department of Biological Sciences, Old Dominion University, Norfolk, VA, 23529. A created wetland is often constructed as part of mitigation packages that attempt to compensate for wetland losses caused by increasing development and farming activities. Few studies have examined whether created wetlands have similar invertebrate fauna as natural wetlands. During the spring of 2000, ground beetles were collected from both natural and created wetlands in Chesapeake, Virginia. Three natural and three created wetlands were sampled. A total of nine different beetle genera were collected from the sites, totaling 152 individuals. More individuals were collected from the created sites than from the natural (86 and 66, respectively). Seven of the genera were found in both the natural and created wetlands; however, these genera were represented unevenly among the sites. A t-test of the Shannon-Weiner Diversity Indices calculated for the sites showed that the diversity of ground beetles was significantly higher in the natural wetlands.

ANT SPECIES DIVERSITY COMPARED IN COASTAL VERSUS BARRIER ISLAND HABITATS ALONG THE EASTERN SHORE OF VIRGINIA. Deborah A. Waller, Old Dominion University, Norfolk, VA, 23529. Ants play important roles in habitats as predators, scavengers, seed dispersers and soil translocators. Some ant species are very specialized and are restricted to specific microhabitats while others are more opportunistic. The objective of this study was to compare the ant fauna of coastal habitats with ants on a nearby barrier island. Barrier islands experience more extreme environmental conditions than the mainland and therefore might be expected to have fewer ant species. Ants were collected from coastal forests and adjacent marshes in Brownsville on the Eastern Shore of Virginia and from the forest and beach on nearby Parramore Island. In each habitat, ants were sampled using baits and pitfall traps every 10m along five 100m transects. Litter was collected at 0m and 100m from each transect and returned to the laboratory for extraction using a Berlese funnel. In addition, foliage sweeps and searches of litter and logs were conducted. A preliminary count revealed 19 ant species from the mainland forest, 10 species from the mainland marsh, and six species each from the island forest and the island beach. Ants characteristic of open, disturbed were common on Parramore Island, and subterranean and litter species were more abundant in the mainland forest.

GEOGRAPHIC VARIATION IN THE BROWN BULLHEAD, *AMEIURUS NEBULOSUS*. Erin D.

Casey & Werner Wieland, Dept. of Biological Sciences, Mary Washington College, Fredericksburg, VA 22401. The brown bullhead, *Ameiurus nebulosus*, has long been speculated to exist as a northern and southern subspecies, *Ameiurus nebulosus nebulosus* and *Ameiurus nebulosus marmoratus*, respectively. This specific problem remains elusive and has not been addressed. A study was conducted using traditional morphometeric methods to resolve this problem. Anal ray, pelvic ray, vertebrae, and gill raker counts, along with color, were used to determine patterns of geographic variation. This study was limited to older preserved specimens from the U.S. National Museum of Natural History. Pelvic ray counts, vertebral counts, and coloration showed geographic variation. However, coloration proved to be the only character supporting subspecific designation. Populations north of the James River, Virginia have a solid dark coloration whereas populations south of the Santee River, South Carolina have a mottled color pattern. Populations from the James River south to the Santee River were found to vary becoming progressively more mottled form north to south. The results are therefore inconclusive with regard to subspecific status.

A METHOD FOR PLANTING LONGLEAF PINE, *PINUS PALUSTRIS* MILLER, ON HIGHWAY RIGHTS-OF-WAY. Phil Sheridan, Meadowview Biological Research Station and Department of Biological Sciences, Old Dominion University, Norfolk, VA, 23529. Longleaf pine is a very rare plant in Virginia with only 4432 trees remaining in the wild. We were interested in utilizing highway rights-of-way to start backup populations of native Virginia longleaf pine within the historic range of the tree and to measure survivorship of longleaf pine planting. Two hundred seventeen seedlings with an average root collar diameter of 1 cm were planted in a cloverleaf in Prince George County, Virginia in mid-January 1999. Ground cover cloth was placed around each seedling, mulch was placed on top of ground cloth, and a bamboo stake with survey tape placed next to each seedling. Mowing of the site during the growing season was carefully coordinated with VDOT staff. Survivorship of longleaf pine after one season was 84% and mulching generally provided effective control of longleaf pine competitors.

WITHIN SITE SELECTION OF ARTIFICIAL CAVITY TREES BY RED-COCKADED WOODPECKERS. A. Nicole Chadwick, Jeffrey R. Walters, & Carola A. Haas, Virginia Tech. Red-cockaded woodpeckers (*Picoides borealis*) are unique in that they excavate cavities in mature living pine trees. This unique feature, however, is thought to limit populations because of the difficulty of cavity excavation and the shortage of trees suitable for excavation. In order to compensate for these limits, artificial cavities often are constructed to increase the number of cavities available to red-cockaded woodpeckers. We examined several artificial cavity tree characteristics to determine how they relate to red-cockaded woodpecker use of artificial cavities within active clusters on Eglin Air Force Base, FL. Additionally, these variables were examined to determine if differences exist between nest trees and other trees within the cluster. Cavity tree characteristics measured were diameter at breast height (DBH), diameter at cavity height (DCH), cavity entrance height (CHT), cavity entrance orientation (OR), tree age (AGE), and relative sap flow (SAP). Active trees had significantly higher DBH ($n=122$, $p=0.0165$), DCH ($n=122$, $p=0.0171$), and CHT ($n=125$, $p=0.0171$). Nest trees had significantly higher CHT than other trees within the cluster ($n=89$, $p=0.0232$). Our results indicate that cavities placed in the largest trees available with high cavity entrances are more likely to be used than other artificial cavities.

COMPARISON OF INSECT CAPTURES BETWEEN WILD-TYPE AND MUTANT GREEN *SARRACENIA JONESII* WHERRY. Phil Sheridan[1&2], Jonathan Humphrey[1], Monique Davies[1], Chris Simon[1], & Nancy Penick[1], [1]Meadowview Biological Research Station and [2]Department of Biological Sciences, Old Dominion University, Norfolk, VA, 23529. Various investigators have proposed that insects are attracted to the carnivorous *Sarracenia* pitcher plants by color, nectar, and scent. Mutant pitcher plants exist which lack the ability to produce reddish-purple pigment due to a recessive allele blocking a late stage of anthocyanin biosynthesis. Normal wild-type plants of *Sarracenia jonesii* produce only cyanidin and thus the role of anthocyanin in capturing insects may be assessed through comparative studies of insect captures between wild-types and mutants. We raised both wild-type and mutant plants from seed and measured pitcher height, mouth width, and mass of insect captures in the 3 year old seedlings. We found that pitcher height and mass of insects captured by mutants was significantly greater than wild-type while there was no significant difference in mouth width.

FISH FAUNA OF THE GREAT DISMAL SWAMP: 1949-1971. Katherine Merten & Werner Wieland, Dept. of Biological Sciences, Mary Washington College, Fredericksburg, Va 22401. The Great Dismal Swamp is located on the Atlantic Coastal Plain in southeastern Virginia and northeastern North Carolina. Just north of the swamp's center is Lake Drummond. The lake is geologically young and its dark, acidic waters are host to numerous species of fish. Field collection notes from the swamp were obtained and entered into database format for analysis. The collections were conducted over a 22 years by Dr. Robert D. Ross and others between March 5, 1949 and May 9, 1971. A total of 41 species were discovered to inhabit the swamp, with *Centrarchus macropterus* being the most frequent species and *Notemigonus crysoleucas* being the most abundant. Several specimens were listed by genus only (*Lepisosteous* sp., *Enneacanthus* sp., *Etheostoma* sp. and *Hololepis* sp.) and their specific identity is yet to be determined. Five species (*Alosa aestivalis, Anchoa mitchilli, Noturus gyrinus, Strongylura marina* and *Menidia beryllina*) were documented in the collection notes which were formerly unknown to the swamp.

THE YELLOW PITCHER PLANT, *SARRACENIA FLAVA* L., RECOVERY PROGRAM. Phil Sheridan, Meadowview Biological Research Station and Department of Biological Sciences, Old Dominion University, Norfolk, VA, 23529. The yellow pitcher plant is a carnivorous plant restricted to fire maintained wetland ecosystems in Virginia. Due to land use changes and urban development this species has suffered significant population declines resulting in only four native populations remaining totaling less than 100 plants. Through a careful process of scientific research an effort to return the yellow pitcher plant to its historic range in Virginia is now being undertaken. This process includes: continued field research for new populations; propagation of extant and extirpated colonies; ecological and reproductive biology studies; reintroduction to the wild of both site-faithful and mixed populations; education of the general public about the importance of these plants and their environment; active programs with local schools involving them in various scientific aspects and on-site reintroductions; a registry with state agencies of all introduced sites, material planted, and origin of stock. A population has now been started in five of the eight historic counties for this species. State highway rights-of-way and wetland mitigation projects have been used for half the reintroductions with several of the sites in their third successful year of reproduction.

RARE PLANTS IN THE CLASSROOM; POTOMAC ELEMENTARY SCHOOL AND THE TOYOTA TAPESTRY GRANT. P. Sheridan[1&2], R. Horman[1], S. Horman[1], S. Gilbert[3], A. Keeton[3], & M. Schmutte[3], [1]Meadowview Biol. Research Station, [2]Dept. of Biol. Sciences, Old Dominion Univ., Norfolk, VA, 23529 and [3]Potomac Elementary School. A basic challenge to educators is how to get young students involved and interested in science and biological conservation. We utilized the carnivorous yellow pitcher plant and longleaf pine to capture students' imagination, answer important scientific questions, and make significant contributions to rare species recovery. We used the Toyota Tapestry Grant to fund and develop our program of scientific study and rare plant reintroduction. Students found that freezing had no effect on breaking dormancy in yellow pitcher plant seed while dilute fertilizer and soil amendments such as Miracid, Superthrive, and a solution of burned pitcher plant leaves significantly increased seedling growth over controls. Students returned over 300 pitcher plant and 95 longleaf pine seedlings to a VDOT wetland mitigation site within the historic range of the species. We think that an important reason for the success of the project was the team effort between teachers, local volunteer master gardeners, and scientific mentors. Student efforts continue with both species in a school yard "mini-nursery".

HISTORICAL RELATIONSHIPS OF MAINLAND RIVER DRAINAGES IN GREECE. E. G. Maurakis[1,2], M. K. Pritchard[1] & P. S. Economidis[3], [1]Science Museum of VA, Richmond, VA 23220, [2]Biology Dept., Univ. of Richmond, Richmond, VA 23173, and [3]Zoology Dept., Aristotle Univ., Thessaloniki 54006 Greece. Historical relationships of 23 river drainages in Greece were determined with distributions of 53 primary freshwater native cyprinids using cladistic methodologies. Analyses resulted in an area cladogram suggesting vicariant events (marine transgression and regression, orogeny, and karst stream autopiracy) as major factors shaping relationships among river drainages and current distributions of the freshwater cyprinid ichthyofauna in Greece. Two biogeographical divisions of river drainages are recognized in Greece: *Ponto-Aegean* and *Neo-Hellas*. The *Ponto-Aegean* in Greece is composed of two subdivisions: *Thracian-East Macedonia*, which is further separated into *Paleo-Aegean* (Evros and Strymon rivers) and *Neo-Aegean* (Filiouris, Nestos, and Gallikos rivers) subdivisions; and the *Macedonia-Thessaly* division (Axios, Loudias, Aliakmon, and Pinios in Thessaly). The *Neo-Hellas* is represented by three subdivisions: *Attiki-Boetia* (Holorema, Sperchios, Atiki, and Kifissos), *Ionian* (Kalamas, Aheron, Louros, Arachthos, Acheloos, Evinos, and Mornos rivers) and *Adriatic* (Aoos River). Methods for testing these hypotheses are presented.

ENVIRONMENTAL IMPACT STATEMENTS IN KARST: THE NEED FOR DETAILED FIELD WORK; CASE STUDY FROM PROPOSED POWER LINE CORRIDOR, SKYDUSKY HOLLOW AREA, BLAND COUNTY, VIRGINIA. Wil Orndorff[2], Joe Thompson[1], and Terri Brown[2], [1]VPI Cave Club, & [2]Virginia Division of Natural Heritage. The preferred and alternate corridors of American Electric Power's proposed 765kV transmission line cross five major belts of karst, which is sensitive to contamination due to rapid conduit flow of groundwater through subterranean channels formed by the dissolution of soluble bedrock. The watershed of one of Virginia's significant karst areas, Skydusky Hollow (SH), is crossed by both proposed corridors. SH includes hibernacula for *Myotis sodalis* and *Corynorhinus Townsendii Virginianus*, federally endangered bat species, as well as a host of rare &/or threatened invertebrate fauna. Data available to AEP was inadequate to document karst in the proposed corridors. Detailed field work performed resulted in 1) extension of the documented watershed via dye trace studies, 2) a near doubling in the documented number of endangered hibernating bats, 3) discovery of a possible new species of amphipod, and 4) location and survey of 14 new or poorly known caves. Had this field work been completed during the scoping phase of the power line routing process, it is doubtful that the proposed route would have been chosen.

Psychology

AGGRESSIVE DRIVING: CONGESTION PER TRAFFIC LIGHT CYCLE AND PREDICTING RED LIGHT RUNNING. Solomon Luckett Jr. & Bryan E. Porter, Psychology Department, Old Dominion University, Norfolk Va. 23529. In this study crowding was explored as a predictor of red light running behavior. Specifically, high traffic volume (high congestion) was expected to predict higher rates of red light running. Two large urban intersections were observed twice weekly for four weeks. Observations occurred during low and high volume hours (9-11 a.m., 4-6 p.m.). For each of 1,972 light cycles, the light status of the last vehicle (color of the light when the last vehicle entered the intersection), the total number of red light runners, and the number of vehicles crossing the intersection (volume) were recorded. Findings indicated that the number of cars entering intersections during each cycle predicted the occurrence of red light running even after controlling for time of day and intersection. The role of frustration with crowded roads as a reason for red light running behavior is discussed.

AN INVESTIGATION OF CONTROL CONDITIONS IN ASCH-TYPE EXPERIMENTS: I. Karen E. Herrera, Thomas E. Mattingly, P. Trey Hannah & James P. O'Brien, Tidewater Community College, Virginia Beach Campus. In his classic studies on conformity and independence 50 years ago, Asch found that almost 95% of his control subjects were error free (% error = 0.08). While dozens of studies have found women to be more conforming than men, people from collectivists cultures to be more conforming than those from individualistic cultures, etc.; few have replicated Asch's control conditions with their subjects. In fact, a recent study (O'Brien, et al., 1999) found no significant differences among male and female experimental and control subjects. In the present systematic replications of Asch's control conditions, only white male college students were as error free (% error = 0.00 & 0.00) as Asch's controls. More variable error performance (% errors 3 to 14.6 times larger than Asch's 0.08) was found for female college undergraduates, male and female community college students, whether the stimulus presenter was an authority figure (as in Asch's case) or a peer (as in O'Brien, et al.). Since studies are premised on the proposition that Asch's stimuli are unambiguous, and since this may not be true for all subjects, caution must be exercised in generalizing Asch's results to groups other than white male college students.

EFFECTS OF TEXT COHERENCE ON CHILDREN'S READING COMPREHENSION. Otey Anne Arnold & Danielle S. McNamara, Psychology Department, Old Dominion University, Norfolk VA. Adults better understand highly coherent text, particularly when they possess less knowledge about the topic. Contrary to this, texts that are created for children are based on Readability formulas, and therefore often contain language that is overly simple and difficult to understand. The focus of previous research has been on adults and not on children who are just beginning to read. This study examines how children are affected by increasing coherence of two typical children's books. 46 second-grade students read two texts, both of which were either high or low coherence versions an expository or fiction text. The results indicated that for less skilled readers, high coherence facilitated comprehension for the more familiar fiction text, but hindered comprehension for the skilled readers. This study has provided evidence that increasing text coherence is important for texts with less familiar concepts.

DETECTION OF VISUAL TARGETS GIVEN VARIOUS FORMS OF DISTRACTER MOTION. Nathan R. Bailey & Mark W. Scerbo, Dept. of Psychology, Old Dominion Univ., Norfolk, VA 23529. When human subjects were presented with a variety of different moving stimuli, differences were found based upon the presence or absence of motion, the type of motion and the density of the targets. The presence of motion is detected much quicker than the absence of motion. Moreover, for motion present searches the appearance of increasing numbers of targets or type of motion have little effect on search times. By contrast, searching for the absence of motion appears to be affected by target density, although at present this effect seems to be limited to the random motion condition. From a broader perspective, these findings suggest that situation awareness is likely to be hampered by the need to look for stationary targets in a field of moving elements.

CHILDREN OF DRUG ABUSING PARENTS: AN EXAMINATION OF FUNCTIONING. Cathy G. Cooke, William Fals-Stewart & Michelle L. Kelley, Department of Psychology, Old Dominion University, Norfolk, VA 23529. Parental substance abuse is linked to many of the problems facing American children. Research suggests that children of substance abusing parents may exhibit high levels of psychopathology. These children may exhibit behavioral problems at home and with their peers and may be involved in delinquent activities. Most studies have focused on parents who abuse alcohol. In this project, we examine parents who primarily abuse substances other than alcohol. The purpose of this project was 1) to examine the psychosocial functioning of school-age children whose fathers were entering treatment primarily for substance abuse other than alcohol; and 2) to determine the degree to which indices of the severity of paternal drug use were correlated with children's psychosocial functioning.Findings indicate that these children exhibit higher levels of psychosocial dysfunction than a normative group of children. These children were also more likely to have scores indicative of psychosocial impairment than were children in the normative sample. Additionally, children's psychosocial functioning was positively correlated to their fathers' Addiction Severity Index. That is, higher addiction severity was related to greater psychosocial impairment in children.

MOTHER'S WORK HISTORY AND PSYCHOLOGICAL ADJUSTMENT: THE EFFECTS ON CHILDREN'S CLASSROOM BEHAVIOR AND PRE-ACADEMIC SKILLS. Margaret S. Hart & Michelle L. Kelley, Department of Psychology, Old Dominion University, Norfolk, VA 23529. Current changes in welfare policy have placed a lifetime limit on benefits. Little information is available on how forcing mothers, who formerly received welfare, into the workforce may impact the development of their preschool age children. The purpose of the present study was to examine the relationships between maternal work history and psychological factors and how these maternal variables influence children's development. In home visits were conducted with 42 Head Start mothers and their children. It was hypothesized that maternal variables would be related to and would subsequently predict child outcomes. Results indicate a moderate negative relationship between maternal stress and pre-academic skills. A negative correlation was also found between the number of months the mother was employed and teacher reported asocial behavior in the classroom.

RETROACTIVE REPORTS OF PARENTING, ADULT ATTACHMENT STYLE, AND DEPRESSIVE SYMPTOMOLOGY IN YOUNG ADULTS. Suzanne M. Mischell & Michelle L. Kelley, Old Dominion University. Research has demonstrated that parent-child attachment is important for adjustment in childhood and adulthood. Attachment style is believed to be stable throughout the individual's life and may impact peer and romantic relationships, interactions between work colleagues, psychosocial functioning, and the individual's ability to adjust to new situations. The focus of the present study was to examine the degree to which retrospective reports of parenting and adult attachment styles were related to young adults' psychosocial functioning. Undergraduate students completed questionnaires assessing retrospective reports of parenting behavior, attachment style, and psychosocial functioning. Individuals who reported harsh parenting (i.e., childhood rejection and psychological control) and insecure attachment styles reported significantly greater depressive symptomology than those who reported a secure attachment style and positive parenting.

RESULTS OF ADDICTION TREATMENT RECOMMENDATIONS FROM A MILITARY PSYCHIATRIC HOSPITALIZATION. Robert M. Storer, Department of Psychiatry, Naval Medical Center Portsmouth, Portsmouth VA & William Fals-Stewart, Psychology Department, Old Dominion University, Norfolk VA. Untreated Substance Use Disorders represent significant costs to society. For the military there is additional concern due to the threat to military readiness. Procedures in place for Psychiatry service at Naval Medical Center Portsmouth result in reliable identification and recommendations for treatment, but it was not known what proportion of those recommended were actually enrolled, nor what variables are reliable predictors of a "successful" referral. A review of records for patients recommended for treatment of substance dependence between January 1, 1998 & July 1, 1999 revealed that only 16% had been enrolled in the recommended treatment. Additionally, none of the variables chosen for study were found to be reliable predictors of success. Comparison of demographic data found that substance dependent patients were younger than those normally enrolled in treatment, and more likely to be recommended for separation from the military although their past psychiatric history and level of dangerousness was found to be no worse than other US Navy subjects. The possible meanings of these findings are discussed as well as suggestions for future studies.

GENDER ATTITUDES AND COERCIVE SEXUAL BEHAVIOR. J. J. Winters, Department of Psychology, Old Dominion University, Norfolk, VA 23529 & S. L. Ellyson, Department of Psychology, Youngstown State University, OH 44555. Male college students (N=62) completed questionnaires containing measures of gender related attitudes, rape myth acceptance, coercive sexuality, and likelihood of raping. Gender related measures included own sex role satisfaction, sex role stereotyping, adversarial sexual beliefs, sexual conservatism, and acceptance of interpersonal violence. The coercive sexuality scale measured history of a wide range of coercive sexual behavior and methods of coercion. Results supported previous findings of a wide spectrum of coercive sexual behavior. Rape myth acceptance and sex role stereotyping were associated with a history of sexual coercion. About one third of the participants indicated a likelihood of raping. However, likelihood of raping was not related to actual history of sexual coercion. Types of sexual coercion were not related to any of the other measures. Own sex role satisfaction, adversarial sexual beliefs, sexual conservatism, and acceptance of interpersonal violence were not associated with coercive sexuality or likelihood of raping. Results indicate traditional correlates of rape may not be related to less severe levels of sexual coercion.

AWARENESS OF HYPERTENSION AMONG AFRICAN AMERICAN COLLEGE STUDENTS. Michelle Pigott, Toya Joyner, Dr. Bertha Davis, & Stase Michaels, Health Studies, Behavior Science Research Center, Hampton University, Hampton, VA 23668. This study examined knowledge of hypertension in 199 African American college students with a mean age of 18.5. It was hypothesized that seniors would be more knowledgeable and would report more risk factor behaviors related to hypertension. A 34-item questionnaire with three subscales related to general knowledge, experiences related to hypertension, and risk behaviors was administered at the end of a college semester at an African American university. Crosstabs by classification and a Pearson Chi Square test were run as statistical anaylses. Results supported the hypotheses showing that freshman were the least knowledgeable when it came to overall general knowledge while seniors reported the most risk behaviors. This suggests that as African American college students get older their levels of awareness regarding hypertension increases and yet by behaviors, they may become more at risk for hypertension. More studies are suggested that would examine how knowledge and behavior / risk factor variables interact on a health issue such as hypertension.

HOW THE ACADEMIC AND SOCIAL LIVES OF AFRICAN AMERICAN COLLEGE STUDENTS AFFECT THEIR EATING PATTERNS. Cecelia Bonner Dr. Bertha Davis, & Stase Michaels, Health Studies, Behavior Sciences Research Center, Hampton University, Hampton, VA 23668. This study examined how the academic and extracurricular activities of college students influence their eating patterns and their use of the student cafeterias. Participants were 67 males and 157 females at a historically black university. Each filled out a 23-item questionnaire related to activities, times, locations, and frequencies of eating patterns as well as nutritional content of meals. Statistical analyses were done using Crosstabs by gender to analyze the data. Results showed that females tend to be more active in extracurricular activities and consequently, report feeling busier than males. Many students miss three to six major meals per week (dinner). Although students compensate for missed meals by snacking, results show that overall nutritional content is markedly low and weighted too heavily by ingestion of starches. A follow up study is suggested to examine how academic success and minor health issues such as colds, fatigue, and stress relate to students' eating patterns.

EFFECTS OF STRESS UNDER HIGH OR LOW PRESSURE CONDITIONS IN AFRICAN AMERICAN COLLEGE STUDENTS. Maro L. Mitchell, Dr. Bertha Davis, & Ms. Stase Michaels, Health Studies, Behavior Sciences Research Center, Hampton University, Hampton, VA 23668. This study examined the effects of stress on 141 African American college students at a historically black university as they took a bogus test. As the experimental design, some were placed in a "high" pressure condition, others in a "low" pressure condition. The test they took was created specifically for this study and consisted of 10 questions, of which six were extremely difficult while four were extremely easy. To create stress artificially, those in the high pressure group were told (a) that others had answered all questions correctly and (b) that these were entrance exam questions at a predominantly white college. A t-test was run as statistical analysis between groups as well as Crosstabs for descriptive analyses. Results showed no significant differences between high and low pressure groups; however, individual questions revealed interesting trends related to how they may handle stress.

THE INFLUENCE OF MEDIA VIOLENCE ON ADOLESCENTS' DELINQUENT BEHAVIOR. Carol D. Roldan & Bryan E. Porter, Psychology Department, Old Dominion University, Norfolk VA 23508. For the past five decades, researchers have studied the effects of media violence on children's behavior and adolescents' imitation. Most studies have found positive correlations between media violence, specifically television violence, and aggression. In recent years, studies have also found positive correlations between parental rejection and delinquency. The current study examined the relationships between media violence, parental rejection, and juvenile delinquency for a sample of 97 freshman students from Old Dominion University between 18 and 20-years-old. Findings revealed that (a) parental rejection was a good predictor of delinquency, (b) media violence by itself did not predict delinquency, (c) but frequency of media violence viewing and exposure to "real" violence experienced during adolescence tended to be better predictors of delinquent behavior.

EFFECTS OF VERBAL AND PICTORIAL IMAGERY ON MEMORY. Daniel M. Birdwhistell & David G. Elmes, Dept. of Psychol., Washington and Lee Univ., Lexington, VA 24450-0303. The present study examined the coding redundancy theory of Paivio by having people recall both the objects and the modality of presentation for items presented as pictures, words, or both pictures and words. Although presenting an item as both a picture and a word enhanced memory, compared to a word alone, memory was no better than for items presented as pictures. Memory for presentation modality was poorest for items presented as both a picture and a word. The results are analogous to those reported by Tracy and associates that showed little advantage to having both auditory and visual images for to-be-remembered items. Thus, the coding redundancy theory does not receive complete support. It is likely that the complex referential connections engendered by two forms of presentation overload working memory and inhibit memory for modality.

THE EFFECT OF ETHANOL ON ELEVATED PLUS MAZE PERFORMANCE OF HYPOGLYCEMIC RATS. Michael G. Grasso, Perry M. Duncan & Juan Constantine, Department of Psychology, Old Dominion University, Norfolk, VA 23529-0267. This ongoing research investigated the effect of ethanol intoxication on hypoglycemic rats. Previous studies have shown that anxiety is experienced during the early stages of the hypoglycemic condition. The focus of this study was to investigate ethanol's ability to attenuate this anxiety. To date, the subjects have consisted of 24 male (Long-Evan) rats in 4 treatment groups of 6 each. In the experimental condition insulin was administered to produce hypoglycemia and ethanol to study its effect. Control conditions were produced using saline injections. Anxiety and activity levels of the subjects were both measured and timed during 5 minute runs in an Elevated Plus Maze (EPM). A significant insulin/ethanol interaction was demonstrated by total time spent in the open arms of the EPM. This clearly indicates reduced anxiety for hypoglycemic rats under the influence of ethanol (F 6.69, $p < .018$, df 1,20). Other significant findings include decreased activity in the hypoglycemic subjects and increased activity while under the influence of ethanol. These findings are important to the diabetic community. Early results suggest that insulin dependent diabetics should be warned of ethanol's ability to mask hypoglycemic symptoms.

ERRORS IN MULTI-CHANNEL AUDITORY SEARCH: LOCALIZATION VERSUS DETECTION. Joseph T. Coyne & Mark D. Lee, Psychology Department, Old Dominion University, Norfolk VA 23529-0267. There has been little research addressing the issue of auditory information processing. However with advances in auditory technology, it becomes increasingly important that we understand human capacity for processing auditory information. The purpose of this study was to gain an understanding of the prevalence of the different sources of errors made in auditory search. Subjects were randomly assigned to either a detection or localization group. Subjects in the detection identified whether the target was presented, and subjects in the localization group identified which speaker emitted the target. The groups were compared on several dimensions including accuracy, reaction time, sensitivity, and the effects of load and speaker position.

BODY IMAGES OF MEN AND WOMEN COLLEGE STUDENTS OVER THE 1980S AND 1990S. April A. Perry & Thomas F. Cash, Old Dominion University. Men and women's body images differ in several respects. Women evaluate their appearance more negatively and are more invested in their looks, as compared to men. Studies have suggested a growing gender gap in body images. In the present study, the authors examined body image changes among college students over the 1980s and 1990s. It was hypothesized that for men and women appearance evaluations have become worse and investments in appearance or appearance orientations have become more important. The authors expected to find that men and women view their bodies more negatively now than in past years, with the negative change even more pronounced for women. Also expected was an increase in investment of appearance for men and women, with the change again being more important for women. Some, but not all of these expected findings were reported.

INFLUENCE OF SPEAKER GENDER ON TARGET DETECTION IN AUDITORY SEARCH. Amy N. Cunningham & Mark D. Lee, Dept. of Psychology, Old Dominion University, Norfolk, VA 23529. The present study investigated the influence of speaker gender on the performance of locating a target in an auditory search task. Controlled combinations of male and female voices and frequency manipulations of male voices were utilized to create several conditions that examined distinctiveness, distractor homogeneity, and artificially altered sound frequency. Participants (N=15) were required to complete a computer-interactive experiment, exposed to four simultaneous streams of auditory data consisting of digits and letters. Results indicated that there was a significant influence of speaker gender on detection. Possible causal factors are discussed.

THE EFFECTS OF TRAINING ON TEAM COHESION. Kari R. Strobel, Robert M. McIntyre & Lara B. Tedrow, Department of Psychology, Old Dominion University, Norfolk, VA 23529. Team cohesion generally refers to a measure of individual attraction to a group in pursuit of either social affiliation or task-related goals. Recognition of the practical importance and theoretical significance of cohesion has led to considerable research into its presumed antecedents and beneficial outcomes. Unfortunately, these investigations have almost exclusively relied on cross-sectional designs, which do not allow for more definitive statements as to whether these correlates lead to, or stem from, cohesion. The primary objective of this study was an attempt to train 25 university student teams made up of 2-6 persons on fundamental teamwork concepts so as to develop measurable improvements in team cohesion. A multiple analysis of variance procedure was used to test for significance between groups over the course of a semester. Results indicated that there was not a significant difference between trainees and controls at baseline; however, compared to the control group, trainees were more cohesive immediately following the training and at one-month follow-up. This research provides insight as to the development and maintenance of cohesive teams, given that most organizations are interested in the creation of team cohesion, rather than simply its cross-sectional correlates.

Statistics Section (VAS Chapter, A.S.A.)

USING JAVA TO TEACH STATISTICS. Sundar S. Dorai-Raj, Christine M. Anderson-Cook & Timothy J. Robinson, Department of Statistics, Virginia Polytechnic Institute and State University, Blacksburg VA 24061. Traditional lectures often do not convey the concepts of statistics in a way that is easily understood or remembered by students in a first course. A series of eight groups of applets have been developed and stored on a universally accessible webpage for students to experience these concepts. Ideas such as extracting probabilities from a distribution, the central limit theorem, confidence intervals, test of hypothesis, control charts, and experimental design are demonstrated. Initial student feedback to the applets has been very positive and students seem better able to retain the concepts. The applets can be found on the author's webpage at http://www.stat.vt.edu/~sundar/java/applets/. Funding for this project was provided by a grant from the Virginia Tech Center for Innovation in Learning and the Center for Excellence in Undergraduate Teaching.

ON THE IMPROVED ESTIMATION OF LOCATION PARAMETERS SUBJECT TO ORDER RESTRICTIONS IN LOCATION-SCALE FAMILIES. Steven T. Garren, Department of Statistics, University of Virginia, Charlottesville, Va. 22904--4135. For some models the isotonic regression estimator is known to universally dominate reasonable unrestricted estimators of the smallest location parameter, $_1$, under a simple order restriction, $_1 \ldots _k$. We show that the former estimator of $_1$ fails to dominate the unrestricted maximum likelihood estimator in terms of mean squared error, when the variances are unknown and unequal in a normal model. The former also fails to universally dominate the unrestricted best equivariant estimator, when the scale parameters are known in an exponential model.A different estimator of $_1$ is shown to universally dominate the unrestricted best equivariant estimator, when the scale parameters are known in an exponential model under more general linear order restrictions. Universal domination results involving the other location parameters and other estimators having bounded support also are discussed.