

## PROCEEDINGS

### ABSTRACTS OF PAPERS, 81st Annual Meeting of the Virginia Academy of Science, May 27-30, 2003, University of Virginia, Charlottesville, Virginia

#### Aeronautical and Aerospace Sciences

TARGET ELIMINATION AND PATHFINDING ALGORITHMS. A.Linklater, B.Smith & B.Tran, Wright Patterson AFB, AFRL, Air Vehicles Directorate, ASC 03-1216, Dayton, OH 45433. The technology of unmanned air vehicles (UAV) seeks to find ways that multiple UAVs can work together in target elimination and path finding techniques that involve little or no human intervention. Target elimination and path finding algorithms (TEPFA) allow for multiple UAVs to execute numerous tasks while considering a large number of variables that could interfere with the UAVs mission. The UAVs mission is to execute tasks such as flight path deconfliction, minimal run-time, pop-up targets, various start and end points, number of UAVs, number of targets, target value, target sharing, and moving targets. Two groups of path finding algorithms were researched - centralized control and distributed control. Centralized control consists of a leader-follower type task execution process in which the followers transmit information to the leader and the leader does all the decision-making. The centralized control system algorithms researched included greedy, random, grid search, a-star, and space division by quad tree algorithms. In a distributive control system, all UAVs involved communicate with each other to determine the optimum tasks for each UAV. An auction-based method was researched and compared to the other centralized control methods. Of the methods researched, auction based, grid search, and random algorithms were able to account for the most variables.

A NEW LOOK AT THE AIRSHIP. M.Leroy Spearman, Systems Analysis Branch, NASA-Langley Research Center, Hampton, VA 23681. An airship system is proposed in which the buoyant lift is enhanced with kinetic lift. The airship would consist of twin hulls in which the buoyant gas is contained. The twin hulls would be connected in parallel by a wing having an airfoil contour. In forward flight, the wing would provide kinetic lift that would add to the buoyant lift. The added lift would permit greater payload/altitude combinations than that which could be supported by the buoyant lift alone. The buoyant lift is a function of the volume of gas and the flight altitude. The kinetic lift is a function of the airfoil section, planform area, and the speed and altitude of flight. Accordingly there are a number of variables that can be manipulated to arrive at a particular design. Particular designs, obviously, could vary from small, lightweight personal systems to very large, heavy-load systems. Several possible uses made achievable by such a hybrid system will be suggested.

A SURVEY OF AIRPLANE DESIGN TYPES. Jillian C. Harper, Industrial and Systems Engineering Dept, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061 & M. Leroy Spearman, Systems Analysis Branch, NASA-Langley Research Center, Hampton, VA 23681. Airplane designs have appeared in many shapes and forms. Were the Wright Brothers right? How should an airplane look and what must be considered in the conceptual design? Fundamentally an airplane should be designed to support itself at specified flight conditions with a specified payload. The lift required for sustained flight could be provided with only a lifting wing and this has given rise to many flying-wing designs. However, some considerations other than sustained flight have lead to a variety of other design features. Requirements for stability, control and maneuverability have lead to the addition of tail surfaces behind the wing (aft tail) or in front of the wing (canard). Special requirements for the accommodation of passengers and cargo have lead to various body arrangements. Thus the large variety of airplane configurations that have appeared have been dictated by different and often conflicting requirements that include performance, mission, and safety.

A CONCEPTUAL DESIGN FOR LARGE AIRCRAFT. M.Leroy Spearman, Systems Analysis Branch, NASA-Langley Research Center, Hampton, VA 23681 & Katie A. Klein, College of Arts and Sciences, University of Virginia, Charlottesville, VA 22904-2020. The quest for increased productivity for commercial air transport aircraft has led to a general increase in aircraft size. Continued increases in size for conventional designs may lead to problems in manufacturing and in airport compatibility. In addition, as the size and weight increase, an increase in lift is required that would tend to increase the intensity of the wing tip vortex. A proposed concept intended to relieve some of the possible problems of extremely large aircraft will be described. The concept consists of an inboard wing having a passenger-carrying fuselage attached to each tip. There are no outboard wing panels and thus no free wing tips. Some results of wind-tunnel tests of a model of the concept will be discussed.

### Agriculture, Forestry and Aquaculture Science

ECONOMICS OF VIRGINIA HYBRID STRIPED BASS POND CULTURE 1992 VS. 2002. Brian L. Nerrie, Coop. Ext., Virginia State Univ., Petersburg VA 23806. Hybrid striped bass aquaculture in Virginia was initiated during the late 1980s due to the decreasing harvest of Atlantic striped bass. Reduced stocks resulted from excess fishing pressure, habitat loss, pollution, and lack of fish conservation practices. From 1992 to 2000 average whole-fish value of \$3.10-\$4.10 per pound encouraged aquaculture production. A majority of enterprises were cage culture operations. During this period the economics of Virginia's hybrid striped bass pond aquaculture dictated the research needs of the industry. Applied research resulted in cost reductions in brood stock management, fingerling production, nutrition, and pond water quality. Market value of whole-fish fell below \$3.00 per pound during 2000. Continued growth of the hybrid striped bass production industry requires profits, and the variable costs associated with feed and fingerling inputs made up most of the production costs. Feed costs have decreased by more than \$0.05 per pound. Breakeven production cost is \$2.33 per pound. Enterprise budgets demonstrate that hybrid striped bass production in Virginia continues to be a viable enterprise. Confounding influences include marine stock management, states rights, disposable income, and traditional societal needs. Advantages of aquaculture production include constant product availability, quality control, and market demand satisfaction.

EVALUATION OF SOUTHERN FLOUNDER OVERWINTERED IN A GREENHOUSE RECIRCULATION SYSTEM. Craig S. Kasper and Scott H. Newton, Virginia Cooperative Extension, Virginia State University, Petersburg, Virginia 23806. Southern flounder were reared in a recirculation system under fall and winter conditions to determine growth, survival and tolerance to fresh water for extended periods. Fish were fed a commercial diet formulated to meet the nutritional requirements of flounder. Water temperature and hardness were closely monitored. Hardness was maintained at 250 ppm total hardness. Feeding behavior was maximal when temperatures reached 28 °C. Feeding activity slowed when temperature dropped, but continued until temperatures reached 4 °C. Survival was excellent at higher temperatures, but decreases with decreasing temperatures. Complete mortality of fish did not occur until water temperature decreases below 4 °C for seven consecutive nights. Flounder can survive exposure to cold temperatures and remain on feed, providing water hardness is adequate.

THE PATHOGENICITY OF AMERICAN TYPE CULTURE COLLECTION *STREPTOCOCCUS INIAE* IN TILAPIA. David Crosby, Cooperative Extension, PO Box 9081, VSU, Petersburg, VA 23806. *Streptococcus iniae* is an emerging pathogen of commercially raised tilapia in USA. The fish losses caused by *Streptococcus* worldwide are estimated at \$150 million. In order to understand the pathogenicity of *Streptococcus*, the American Type Culture Collection (ATCC) of *Streptococcus iniae* (29177 & 29178) was obtained to do preliminary infectivity and virulence studies using tilapia. The ATCC *Streptococcus* was grown in Tryptic Soy or BHI broth for 48 hrs before harvesting bacteria for experimental use. Inocula were made with bacteria suspended in sterile phosphate saline.

Tilapia were given injections containing 0.1cc to 0.4cc of 1:100 dilution of stock bacteria or a 0.2cc of stock bacteria. Tilapia were injected intraperitoneally, intramuscularly, into the brain, eye or nares using both ATCC strains. Tilapia were also exposed to bacteria by bath treatment (2 gallons with 10 ml of stock bacteria). The skins of some tilapia were scraped for bath treatment. After four attempts to infect tilapia with ATCC strains resulted in no infections of *Streptococcus iniae* in tilapia.

MAXIMIZING THE GREENHOUSE ENVIRONMENT FOR TOMATO PRODUCTION. Mark E. Kraemer & Françoise Favi. Agricultural Research Station, Virginia State University. The Dutch determined ideal temperature, humidity and light conditions for greenhouse tomato production. Although it's not possible to maintain these conditions, especially for limited-resource operations, these parameters are important determinants for fruit quality, quantity, and earliness. Three regional greenhouses were continuously monitored with a temperature and humidity data logger during the 2002 winter/spring-growing season. The results showed that ideal conditions were achieved only about 20% of the time with humidity the parameter hardest to control. Humidity peaked the first hour after sunrise, when additional ventilation could be effective. Temperatures may be set too high, or raised too early in the morning, before there is adequate light intensity for optimum photosynthesis. This wastes energy and may reduce relative humidity to sub-optimum levels. Air temperature on overcast or rainy days may also be too high for the available light intensity. Recent tests of a light intensity data logger indicated that mid-day light intensity varied 6-fold within a period of a week. The development of more sophisticated computer programs to monitor and/or control heat, light, and ventilation could reduce energy usage and enhance greenhouse tomato quality and yield.

ELECTRON MICROSCOPY STUDY OF GLANDULAR TRICHOMES FROM *VERNONIA GALAMENSIS* (CASS.) LESS LEAVES. F. Favi, E. Westbrook, T. Mebrahtu, & M. Kraemer. Agricultural Research Station, Virginia State University, Petersburg VA 23806. The genus *Vernonia* contains more than 500 species and is now divided into several subspecies and varieties. These plants have potential as a new oilseed crop and leaf extracts are being investigated for drug and pesticide discoveries. This is a contribution toward the investigation of the trichome constituents of *V. galamensis* plant. Light, scanning and transmission electron microscopes were used for this study. Both glandular and non-glandular trichomes were observed on leaves but peltate glandular trichomes were only present at the lower side of leaves. Different developmental stages of one, two, four, eight and ten-celled trichomes were observed and photographed. One to eight-celled trichomes are immature stages. The mature ten-celled trichome has a pair of support cells and four pairs of secreting cells. The topmost pair of cells develop a large sub-cuticular space (head) that filled up gradually with secondary metabolites produced by the secreting cells. Secreting cells debris observed in head showed self toxicity of secreted product. Ethanol extract of whole leaves had pesticidal activity against whiteflies. HPLC analysis showed multiple peaks consistent with sesquiterpene lactones.

CONTROL OF WIREWORMS IN POTATO WITH ENTOMOPATHOGENIC NEMATODES. Vonny M. Barlow<sup>1</sup>, Thomas P. Kuhar<sup>2</sup> & Edwin E. Lewis<sup>1</sup>, <sup>1</sup>Dept. of Entomology, Virginia Tech. Blacksburg, VA. 24061 and <sup>2</sup>Dept. of Entomology, Virginia Tech. Painter, VA. 23420. We compared the efficacy of entomopathogenic nematodes and phorate against wireworms (Coleoptera: Elateridae) in 'Superior' Irish potatoes. Entomopathogenic nematodes and phorate treatments reduced the number of damaged tubers compared with the control. Complementary container experiments in the field showed wireworm mortality in nematode-treated soil was higher than the untreated control.

**Archaeology**

(No meeting this year)

**Astronomy, Mathematics and Physics**

PREONS, NUCLEON FISSION CHAIN REACTIONS, AND CELESTIAL POWER TRANSIENTS. Charles A. Bly, Dept. of Nuc. Engr., UVa. Charlottesville VA 22903. Nuclear fission and fusion power have developed as bombs and power plants for the past sixty years. One can move on to explore the natural limits of nuclear power development. The author began research into nucleon fission reactors in 1990 at Westinghouse in Pittsburgh, Pennsylvania. The author's research goal is to facilitate the extraction of power from more fundamental layers of matter. Interactions can be seen as preon surface chemistry amid the orbiting preons of quarks and leptons. Among reactions providing subnuclear fission chain reaction power are neutrino-stimulated proton decay chain reactions. Supernovae and hypernovae provide natural prototypes from which one can glean valuable insights. One can compare the nucleonics of a supernova "reactor" to that of a commercial nuclear power plant. Microscopic fission cross sections decrease by 21 orders of magnitude. Fuel density increases 13 orders of magnitude. Reactor fuel volume increases 9 orders of magnitude. Both reactor types are driven by neutral radiations with long mean free paths. Hence, criticality formulations for nuclear fission reactors can be applied to celestial nucleon fission reactors. Baryon number conservation and its violation can be managed by engineering lepton-Z boson interactions. Dark matter acts as a catalyst.

ROLE OF OPTICAL FEEDBACK DELAY TIME ON DIODE LASER BEHAVIOR. Rachel Chisolm, Jordan Bittle, Courtenay Glisson & David Sukow, Department of Physics and Engineering, Washington and Lee University, Lexington Virginia 24450. We studied the fundamental properties of semiconductor diode lasers under conditions of delayed optical feedback. Optical feedback occurs when the laser beam is reflected directly back into the laser. This feedback causes a chaotic system with power dropouts. We measured the average time between power dropouts for long external cavities and found the relationship between the cavity length and the average time between power dropouts. Our preliminary research seems to indicate a positive relationship between the cavity length and the average time between power dropouts.

LIGHT FLASHERS: TESTING AND PROTOTYPING. Charles W. Arnold & Kevin L. Giovanetti, Department of Physics, James Madison Univ., Harrisonburg VA. 22807. In an effort to calibrate 360 photomultiplier tubes for the MuLAN experiment, we are building tiny LED pulsers. The pulsers borrow their design from pulsers use in the KamLAND project but with modifications to tailor them to our needs. Our prototype encountered several setbacks including signal translation, power distribution, and undesired pulse properties. All of these problems have been corrected through careful investigation of the properties of our pulse producing system.

BARNARD'S STAR: PLANETS OR PRETENSE. J. L. Bartlett, Dept. of Astronomy, Univ. of Virginia, Charlottesville VA 22903 & P. A. Ianna, NSF, Arlington VA 22230. A time-series analysis of photographic plates taken of Barnard's Star at the Leander McCormick Observatory (LMO) reveals no evidence of periodic perturbations indicative of planetary companions. These observations indicate a parallax of  $0''.5482 \pm 0''.0017$  and a proper motion of  $10''.3324 \pm 0''.0002/\text{yr}$ . In 1963, Van de Kamp claimed to detect the first extra-solar planet orbiting this star. He used Sproul Observatory plates from 1938 to 1981 and determined that 2 companions with 12- and 20-yr orbits best fit the perturbation he observed. He estimated that both objects are each less massive than Jupiter. Using various techniques, other observers failed to detect clearly any companions. Of these, only one search was sufficiently sensitive to detect planetary bodies. In view of the continuing controversy, we reviewed over 900 exposures made on photographic plates between 1969 and 1998

at LMO. After the LMO microdensitometer scanned the plates, we calculated the parallax and proper motion. We combined the resulting residuals into annual normal points for which we analyzed separate Lomb periodograms in RA and dec. In neither case does the power at any frequency indicate a signal at a significance level of 50% or better. We acknowledge support from NSF grant AST 98-20711 and from Litton Marine Systems, Inc.

BEAM TESTING AT PSI: STOPPING MUONS IN A TARGET. Andrew W. Werner & Kevin L. Giovanetti, Department of Physics, James Madison Univ., Harrisonburg VA. 22807. The  $\mu$ Lan collaboration is an effort to determine the lifetime of the muon to one part per million. Experimental work for this is done at the Paul Scherrer Institute (PSI) in Switzerland. The muon beam used is an offshoot of the neutron spallation experiments at the cyclotron on site. This beam must then be focused and sent to a sulfur target inside a soccer ball shaped detector, which will monitor the decay rate of the muon thereby giving the lifetime for the particle. The detector incorporates 360 individual photomultiplier tubes (PMTs), all of which must be calibrated. The calibration is being done with a modified version of the KamLAND LED pulser for <10ns pulse widths of blue (400nm) light coupled with a fiber optic to deliver the light directly to the PMTs.

CHANDRA OBSERVATIONS OF NUCLEAR X-RAY EMISSION FROM A SAMPLE OF RADIO-LOUD ACTIVE GALAXIES. Jessica Gambill<sup>1</sup>, R. M. Sambruna<sup>1</sup>, J. Pesce<sup>1</sup>, G. Chartas<sup>2</sup>, C. C. Cheung<sup>3</sup>, L. Maraschi<sup>4</sup>, F. Tavecchio<sup>4</sup>, & C. M. Urry<sup>5</sup>, <sup>1</sup>Dept. of Phys. & Astro., George Mason Univ., <sup>2</sup>Dept. of Astro. & Astrophys., Penn State Univ., <sup>3</sup>Dept. of Phys., Brandeis Univ., <sup>4</sup>OSSA di Brera and <sup>5</sup>Dept. of Astro., Yale Univ. We present the X-ray properties of the cores of sixteen radio-loud quasars (RLQs) and one low-power radio galaxy observed with the *Chandra X-ray Observatory (CXO)*. The targets were selected for large-scale radio properties to optimize new detections from X-rays in the regions of resolved radio jets. The study of the nuclei was based on the emission detected in a 2''-radius aperture, with the photon counts limited to the range 0.5-8 keV for optimal sensitivity. Timing analysis finds one variable source (~25 minutes). One source shows evidence from spatial analysis for an X-ray halo (~25 kiloparsecs). Analysis of the X-ray spectrum finds that the favored model is a power law plus fixed Galactic absorption ( $N_H$ ) with luminosities,  $L_{2-10\text{keV}} \sim 10^{45}$  ergs  $s^{-1}$ . Six spectra have soft (<1.2 keV) energy excess and one source has an intrinsic absorber ( $N_H \sim 5 \times 10^{23} \text{ cm}^{-3}$ ). A surprising result for this beamed sample is the evidence for Fe K-shell line emission (at 6.4 keV) found in two or three sources. This is a new property for the nuclear emission of RLQs. Statistical analysis of the sample shows neither a trend for the photon index generally, nor a trend within the core- and lobe-dominated sub-groups.

SILICON BASED THERMO-ELECTRIC MICROSENSORS. Steven L. Hearn, Integrated Science and Technology, James Madison University, Harrisonburg VA 22801. The purpose of this research is to investigate, design, fabricate, and characterize thermal microsensors. This project includes determining effective designs for thermopiles, finding appropriate materials with high Seebeck coefficients, and characterization and calibration of fabricated microsensors. Magnetron sputtering and evaporation deposition techniques are employed to fabricate thin films while photolithography and chemical etching are used to pattern the films. Metal-metal and metal-boron doped silicon semiconductor junctions are investigated. Prepared microsensors are inspected microscopically and characterized using surface profilometry and Scanning Electron Microscopy with Energy Dispersive X-Ray Analysis (SEM-EDS) to determine the surface and volume characteristics. Seebeck sensitivity measurements and four-point probe resistivity techniques have been employed to determine important electrical characteristics. The results of these studies and applications of this research to thermal microsensors, energy measurements, and gas sensing are discussed.

PREPARING STUDENTS FOR PRODUCTIVITY IN FIBER OPTICS TEST AND MEASUREMENT. Donald H. Reinhart, Tektronix, Inc., Beaverton OR 97077. The advent of Internet technology is contributing to significant growth in the volume of digital information being transmitted through communications networks. In the United States, the information technology industry has increased from 5.6% of the Gross Domestic Product in 1992 to 8% in 2000. Fiber optics offers many advantages as a conduit for data transmission, and various innovative techniques have been implemented to leverage bandwidth requirements in the communications network. Dense Wavelength Division Multiplexing (DWDM) is one such technique that currently enables transmission rates of more than one Terabit-per-second over a single optical fiber. Students graduating from today's university programs will encounter the challenge of applying solid-state physics and optics to optical communications technology. The goal of communications service providers is to continually increase bandwidth while maintaining a profitable cost structure. Students with a strong understanding of semiconductor properties and optical principles of lasers and polarization will be positioned for productivity in design and test applications where innovative developments in reducing costs and improving performance of future generation optical devices and systems are critical.

THE IDENTIFICATION AND CHARACTERIZATION OF POLAR MESOSPHERIC CLOUDS (PMCS) IN HALOE DATA. Jonathan E. Wrotny & James M. Russell III, Department of Physics, Center for Atmospheric Sciences, Hampton University, Hampton VA 23668. Data from the Halogen Occultation Experiment (HALOE) are being used to identify and characterize the physical properties of polar mesospheric clouds (PMCs). This analysis is accomplished using the 22 polar summer seasons (11 northern and 11 southern hemisphere) seen by HALOE. An algorithm is described that screens the HALOE data for PMCs and results of these analyses are presented. In particular, the number of PMCs and occurrence frequency per season are shown. Several properties of the clouds are also presented including the altitude and latitude distribution of the clouds. The distributions of PMCs over time and spatial coordinates show good agreement with other satellite studies of PMCs such as SME, SNOE, and SBUV.

TEMPEST IN A TEAPOT: UNDERSTANDING THE ELECTRICAL NATURE OF TORNADOS. Joseph W. Rudmin, Physics Dept., James Madison Univ., Harrisonburg VA 22807. A review will be presented of the idea that tornados are electrically driven. Included will be a brief history of the literature and researchers, and published evidence supporting and opposing the theory. Possible mechanisms consistent with the evidence will be discussed. A key issue is whether the energy of the tornado propagates from cloud to ground or from ground to cloud. An emulation using vortices in boiling hot water will be used to illustrate the two different behaviors of these two possibilities.

DEVELOPMENT OF SCANNING TUNNELING MICROSCOPE PROBE TIPS. Sean M. Walsh & W. Christopher Hughes, Dept. of Physics, James Madison University, Harrisonburg VA 22807. *In situ* scanning tunneling microscopy is dependent upon the quality and design of the probe tip. In order to image surfaces which form oxide layers, the surface must be placed in a weak acid. If a scanning tunneling microscope (STM) probe tip is not properly insulated from interactions with the surrounding weak acid, ions will interact with the probe tip drowning out the signal coming from the imaging surface. Yet a conducting oxide free area must exist at the apex of the probe tip in order to allow for tunneling. Several methods have been used in order to insulate STM probe tips from these faradic currents, yet most methods do not guarantee reproducible quality tips. Coating an STM probe tip in a photosensitive polymer such as photoresist, and then exposing the probe tip to ultraviolet light at the proper wavelength and removing the exposed photoresist using a developing agent would result in a exposed surface area on the order of the wavelength of ultraviolet light used. Alternatively coating the STM probe tip in photoresist and allowing surface tension to expose the apex of the probe tip would result in a useable STM probe tip, these probe tips have been experimentally tested to yield leakage currents of 20 pA, while the ultraviolet exposed tips have not yet been tested.

USING *MATHEMATICA* IN UPPER DIVISION CLASSES: EXAMPLES AND HINTS. Richard L. Bowman, Dept. of Physics, Bridgewater College, Bridgewater VA 22812. The power of *Mathematica* to solve algebraic, calculus and other mathematical problems in either analytical or numerical form and to plot these results serves well the objectives of upper-level undergraduate physics courses. Examples from classes in electricity and magnetism, quantum mechanics and classical mechanics and from research illustrate these capabilities. They include making 3-D surface plots of infinite sum solutions found by separation of variables in 2-D, calculating numerical solutions to the eigenvalue problem arising from solving for the energies and wavefunctions for a 1-D particle in an infinite well with a finite barrier, solving numerically the differential equation associated with the oscillations of a stretched rubber band and plotting the results, and creating publication-quality graphs of molecular spectra obtained during research.

A MID-INFRARED SPECTROSCOPIC AND X-RAY IMAGING STUDY OF LINER GALAXIES. Rachel P. Dudik<sup>1</sup>, Shobita Satyapal<sup>1</sup>, Rita Sambruna<sup>1</sup> & John McNulty<sup>2</sup>, <sup>1</sup>George Mason University, Fairfax VA, <sup>2</sup>St. John's College, Annapolis MD. Low Ionization Nuclear Emission-line Regions (LINERs) represent as much as one third of all nearby spiral galaxies and nearly half of all nearby early-type galaxies, LINER research lends critical contributions to numerous other astrophysical subjects, including X-ray background studies, galaxy formation studies, and studies of Active Galactic Nuclei (AGN). We present herein archival, high-quality infrared spectroscopic data from the *Infrared Space Observatory*'s Short Wavelength Spectrometer and corresponding archival X-ray imaging from *Chandra* for 28 LINER galaxies. In the first part of this presentation, I will illustrate the purposes behind LINER research: What are LINER galaxies and why are they important? In the second part of this talk, I will present the observational results of this multi-wavelength study and draw upon the main conclusions for this set of objects. This research was funded by NASA grant: NAG5-11432.

### Biology

TWO NEW SPECIES OF FUNGI (DEUTEROMYCOTA) OCCURRING ON ANCIENT WOOD FROM THE CALVERT FORMATION IN VIRGINIA. Katherine W. Privratsky & W. Wallace Martin, Dept. of Biology, Randolph-Macon College, Ashland, VA 23005-5505. Two new acidophilic species of the Deuteromycota have been isolated from Middle Miocene sediments at a stone quarry in Caroline County, Virginia. The first organism is a new species of the genus *Acrodontium*, section *Grisea* de Hoog. It differs from other *Acrodontium* species in the dimensions and shapes of its conidiogenous rachis and conidia, in the pigmentation of its colonies, and in its maximum growth and conidial production at pH 3 and 4. The second organism is a new species of the genus *Sporothrix*. It differs from other *Sporothrix* species in the shapes and dimensions of its conidia, in the production of hyaline, nonpigmented colonies, and in its lack of growth at 35-37 °C.

CHARACTERIZATION OF THE HK-2 HUMAN PROXIMAL TUBULE KIDNEY CELL LINE FOR STUDIES OF 1,25(OH)<sub>2</sub>D<sub>3</sub> ACTIVATION. Amandeep Bajwa & Matthew J. Beckman, Department of Biochemistry and Orthopedics, Virginia Commonwealth University, Richmond VA 23298. The renal proximal tubule (PT) is the chief endocrine cell of the vitamin D endocrine system. Nutritional hyperparathyroidism induced by dietary calcium (Ca) restriction leads to forceful down-regulation of 1,25-(OH)<sub>2</sub>D<sub>3</sub> receptor (VDR) transcription in the PT. Our goal was to develop an in vitro human PT cell model to examine the transcription of VDR. In this study we used the human epithelial HK-2 cell line derived from the PT. The cell line is shown to be responsive to calcium and PTH treatments as shown by Real-Time RT-PCR analysis of VDR, and the effects were in accordance with previous in vivo data. PTH caused a reduction in VDR transcript levels that was greater in the absence of calcium, indicating that extracellular Ca modulates the effect of PTH on VDR transcription. The HK-2 cell line should prove to be a powerful new tool to characterize the DNA elements and factors regulating VDR transcription in proximal kidney cells.

EFFECTS OF HEPARIN AND ASPIRIN TREATMENT ON FREQUENCY OF PREGNANCY LOSS INDUCED BY LIPOPOLYSACCHARIDE INJECTION IN CD-1 MICE. Jennifer C. Winfree<sup>1</sup>, Carolyn M. Conway<sup>2</sup>, & Arthur F. Conway<sup>1</sup>, <sup>1</sup>Dept. of Biology, Randolph-Macon Coll., Ashland, VA 23005 and <sup>2</sup>Dept. of Biology, Virginia Commonwealth Univ., Richmond, VA 23284. Lipopolysaccharide (LPS) from the outer cell wall of Gram-negative bacteria causes pregnancy loss when injected into pregnant mice. We evaluated the effectiveness of heparin and aspirin for prevention of LPS-induced pregnancy loss. Pregnant CD-1 mice were treated with aspirin alone, heparin alone, or both aspirin and heparin in varying dose combinations on days 8 through 12 of gestation and then injected intravenously with *E. coli* LPS on day 9 of gestation. LPS injection significantly increased the frequency of pregnancy loss. Aspirin treatment, heparin treatment, and all combinations of both drugs slightly reduced the frequency of LPS-induced pregnancy loss (not statistically significant). The dose-independent partial inhibition of LPS-induced pregnancy loss by aspirin and heparin treatments suggests that clotting processes may contribute slightly to LPS-induced pregnancy loss but that clotting processes are probably not a major mechanism leading to pregnancy loss in LPS-treated mice. Support by a Virginia Academy of Science Undergraduate Student Research Award is gratefully acknowledged.

CHARACTERIZATION OF THE MAGNETORECEPTION MECHANISM IN *DROSOPHILA MELANOGASTER*. D. H. Dommer & J. B. Phillips, Dept. of Biol., Va. Polytechnic Inst. and State Univ., Blacksburg, VA 24061. Although use of the geomagnetic field in spatial orientation has been documented in a wide range of taxa, the underlying morphological structure(s) and physiological mechanism(s) of this unique sensory modality remain an enigma. Studies carried out by this laboratory and others have provided evidence consistent with two different magnetoreception mechanisms: (1) a light dependent mechanism involving specialized photoreceptors, and (2) a non-light dependent mechanism utilizing ferromagnetic particles (i.e. a magnetite-based system). The focus of experiments in our laboratory concerns the light dependent magnetoreception mechanism found in migratory birds and eastern red spotted newts. Neither represents a model organism with a described genome, advanced knowledge of neural anatomy, and the ability to utilize molecular biology or genetic knockouts to manipulate experimental organisms. These techniques are crucial to investigating the fundamental properties of the magnetic compass in light-dependent organisms. *Drosophila melanogaster* provides all of these options in a non-migratory organism that is amenable to training and testing under simple conditions.

CONTROL OF LACTASE ACTIVITY BEYOND THE LAC-OPERON. M. A. Captieux<sup>1</sup>, T. E. Swain<sup>2</sup>, A. A. Mills<sup>3</sup>, L. M. Mills<sup>3</sup>, D. Kuruvilla<sup>4</sup>, L. Liang<sup>4</sup>, & C. W. Vermeulen<sup>5</sup>, <sup>1</sup>Univ. of Edinburgh, Scotland EH16 5AY, <sup>2</sup>Jamestown High School, Williamsburg, VA 23185, <sup>3</sup>Messiah College, PA 17027, <sup>4</sup>Midwood High School, Brooklyn, NY 11210, <sup>5</sup>Science-Projects.Com, Williamsburg, VA 23185-5360. As an on/off switch for lactase activity, the lac-operon is a type of 'coarse' control. Using Lineweaver-Birk kinetics, this group found that galactose served as a 'fine' control mechanism by regulating reaction rate via competitive feedback inhibition of lactase both in vitro (using commercial Lactaid<sup>®</sup>), and in vivo (using a lac-induced strain of *E. coli* gal<sup>-</sup>). Growing in varying amounts of gal and with 1% lac, the bacteria fermented lac and had ordinary levels of lactase when [gal] < [lac]. However, when [gal] > [lac], the cells became phenotypically lac<sup>-</sup> even though ONPG testing showed that they had elevated levels of lactase. Presumably, with lactase blocked, depressed [ATP] encouraged the cAMP-pathway promoting operon expression leading to still more enzyme. Modules of teaching lab protocols are found at [www.science-projects.com/VAS/VAS2003.htm](http://www.science-projects.com/VAS/VAS2003.htm) as extensions to the classic labs exercises dealing with lac-operon induction in microbiology, genetics and biochemistry courses.

EXPLORING THE MAGNETIC SENSE IN LABORATORY MICE, STRAIN C57BL/6J. N. M. Edgar & J. B. Phillips, Dept. of Biol., Va. Tech., Blacksburg VA 24061. Magnetic compass orientation occurs in numerous species including birds, newts, flies, and mammals. In birds, newts, and flies, the mechanism of magnetic compass orientation appears to be light-dependent as evidenced by the absence of magnetic orientation in complete darkness and shifted orientation under certain wave-lengths of light. In contrast, mole-rats (the only mammal that has been studied in detail, but which are functionally blind and live underground) are able to use their magnetic compasses in total darkness, indicating the presence of a non-light-dependent magnetic compass. We studied the type of magnetic compass mechanism used by more typical rodents, strain C57BL/6J laboratory mice. Mice were trained to build their nests in a specific direction relative to the magnetic field. Testing occurred overnight in a circular arena with food and nest material provided at the center. The bearing of the nest (typically built along the edge of the arena) was recorded the next morning. Mice are able to learn to position their nests in a specific direction relative to the magnetic field (mean vector bearing =  $17^\circ$ , where trained direction =  $0^\circ$ ;  $r = 0.67$ ;  $p = 0.001$ ). This assay will be invaluable to future experiments aimed at characterizing the genetic and behavioral components of the magnetic compass mechanism in rodents.

THE INDUCTION OF APOPTOSIS IN LUNG FIBROBLASTS USING THE GAP JUNCTIONAL INTERCELLULAR COMMUNICATION OF SV40 TRANSFORMED FIBROBLASTS. Brett A. Ozanich & Rosemary Barra, Dept. of Biol. Sciences, Mary Washington College, Fredericksburg, VA 22401. Antitumor suicide gene therapy is an emerging strategy against cancer. It consists of the introduction into the cells of a gene capable of converting a nontoxic prodrug (ganciclovir) into a cytotoxic drug. An advantage of this system is the bystander killing effect where by virally transduced cells exposed to ganciclovir are lethal to surrounding nontransduced, tumor cells. By the observation of morphological changes, caspase 8 activity and comet assays, apoptosis was shown to be associated with the killing effect of ganciclovir on SV40 transduced, CCL-75.1 transformed lung fibroblasts. Cell viability was decreased by 50% following a 24 hr exposure to 3 mg/mL GCV. These results suggest that GCV was phosphorylated into the cytotoxic agent by the viral enzymes. Additionally, decreased cell viability was found to be associated with nontransduced CCL-75 lung fibroblasts grown with CCL-75.1 lung fibroblasts and treated with GCV. These results verify the presence of the bystander effect and implicate gap junctional intercellular communication as the mode of ganciclovir-P transfer between virally transduced and nontransduced cells.

MACS ANALYSIS IN PERIPROSTHETIC MEMBRANE. Mengnai Li<sup>1</sup>, William A. Jiranek<sup>2</sup> & Matthew J. Beckman<sup>3</sup>, Department of <sup>1</sup>Anatomy, <sup>2</sup>Orthopaedics and <sup>3</sup>Biochemistry, Virginia Commonwealth University, Richmond, VA 23298. Osteolysis implies complete bone resorption (complete radiolucency) and has been a major complication after Total Joint Replacement (TJR). Periprosthetic membrane (PM) is usually found in revision surgery due to osteolysis. Macrophages and fibroblasts were found to be the major cell types inside the membrane. Using MACS magnetic cell sorting system, viable CD14+ macrophages and fibroblasts have been successfully separated from the PM retrieved from revision TJR. With iliotibial band as negative control, the lesion part of PM was found to have more CD14+ macrophages. Mast cells were mostly distributed in the CD14- group. Future purified cell separation will facilitate measurement of the ratio of RANKL/OPG in either macrophages or fibroblasts and will be a possible breakthrough for understanding the mechanism of osteolysis after TJR.

THE SMALL MAMMALS OF ISLE OF WIGHT COUNTY, VIRGINIA (AS REVEALED BY PITFALL TRAPPING). Robert K. Rose, Department of Biological Sciences, Old Dominion University, Norfolk, Virginia 23529-0266. The small mammals of Isle of Wight County, Virginia were surveyed in mid-winter using pitfall traps placed in the early successional habitats

of powerline rights of way. Trapping conducted for 3 weeks on each of twelve 0.25-ha grids yielded 252 small mammals of 7 species, 3 of shrews and 4 of rodents. The least shrew (47.1%) and eastern harvest mouse (21.8%) comprised the majority of the total and were found on most grids. Each remaining species was uncommon by comparison, with the woodland vole being the rarest (n=2). Of the three microtine rodents, the southern bog lemming was the most unusual, occurring up to 40 km west of the Dismal Swamp, its supposed refugium. Of the seven species, only southern bog lemmings and woodland voles were breeding during January. This information is believed to be the first report of the small mammals of the county.

NOCTURNAL THERMOREGULATION IN THE WHITE-THROATED SPARROW. E.K. Dilger, L.E. Williams, A.S. Dolby, & J.G. Temple. Department of Biological Sciences, Mary Washington College, Fredericksburg, VA 22401. Nocturnal thermoregulatory strategies of small songbirds have been little investigated under field conditions. We used temperature-sensitive radio-transmitters to determine whether White-throated Sparrows employ nocturnal hypothermia during winter. We obtained skin temperature measurements on 24 free-ranging sparrows between 1300 and 1400 hours and between 0200 and 0300 hours for three days and nights per subject. The average nightly skin temperature reduction per individual was 3.44 (SD = 0.96) degrees C. Thirteen sparrows reduced their skin temperatures by an average of more than three degrees C. The maximum single temperature reduction observed was 7.0 degrees. White-throated Sparrows, therefore, exhibit variation in use of nocturnal hypothermia. We found a significant negative correlation between magnitude of skin temperature reduction and nighttime ambient temperature and a marginally significant negative correlation (p= 0.06) between depth of hypothermia and a physical condition index calculated by dividing each subject's body mass by the cube of its wing chord length. Funded by a VAS Undergraduate Research Grant, a Sigma Xi Grant-in-Aid of Research, and a Mary Washington College Undergraduate Research Grant.

GROWTH RATE OF *ONCOPELTUS FASCIATUS*, THE MILKWEED BUG, RAISED AT DIVERSE TEMPERATURES. C. Eninger & G. F. Birchard, Dept of Biology, George Mason University. Fairfax, VA 22030. Invertebrates cultured at lower temperatures generally take longer to hatch, but produce larger adults. The one exception to this rule may be arthropods, which show the opposite trend. Milkweed bug (*Oncopeltus fasciatus*) eggs were cultured at a range of temperatures from 15 to 31 °C, which produced a hatching curve showing that higher temperatures resulted in shorter hatching time. Growth curves were developed at 18, 25, and 29 °C. The higher temperatures produced larger individuals in a shorter amount of time. The 18 °C insects failed to reach sexual maturity indicating that at 18 °C or lower temperatures the milkweed bug would be unable to survive. These results revealed that higher temperatures result in shorter development time and larger insects. This consistent was with the trend that arthropods are the exception to the hypothesis that cooler temperatures produce larger individuals in invertebrates.

TEMPORAL AND SPATIAL DISTRIBUTION OF BOTTLENOSE DOLPHINS (*TURSIOPS TRUNCATUS*) IN AN URBANIZED ESTUARY. K. M. Foss and J. R. Reed, BCES Dept., Christopher Newport Univ., Newport News, VA 23606. The Elizabeth River represents a unique habitat for bottlenose dolphins. The entire river is bounded by industrial, urban, suburban, commercial shipping and military facilities. This river is ranked as one of the most polluted on the east coast. Dolphins are migratory in this area, appearing from May through October. Our studies were undertaken during 2000 from May to August and November to December, and in 2001 from January to October. Standard small boat passive observation techniques were used, along with photography of individuals. A total of 72 cruises were made with 41 encounters in the two years. A total of 495 individuals were identified by photo ID, and a Caughley recapture estimate was used to give a population estimate of 678. The dolphins appeared in small numbers in April and May, increased in June to a peak mean of 40 animals sighted per encounter in July.

This mean decreased to 27 in August and September and dropped to 0 from November to March. The group size ranged from 1 to over 80. Encounters per cruise peaked at a mean of 1 in July, 0.62 in August and 0.76 in September. Despite a peak of births in the area in May-June, there was little mating during June or July, with the incidence of sexual activity peaking in September.

IDENTIFICATION OF REGULATORY BINDING SITES AND CORRESPONDING TRANSCRIPTION FACTORS INVOLVED IN THE DEVELOPMENTAL CONTROL OF 5'NUCLEOTIDASE EXPRESSION IN *DICTYOSTELIUM DISCOIDIUM*. N.S.Wiles, C.M. Eristi, M. Ubeidat, B.R. Joyce & C.L. Rutherford, Dept. of Biol., Va. Polytechnic Inst. & State Univ., Blacksburg VA 24061. The transcriptional control of the developmentally expressed gene encoding 5'-nucleotidase (*5nt*) in the model system *Dictyostelium discoideum* was analyzed by creating 5' and internal deletions in the sequence immediately upstream from the coding region. Subsequent fusions of the deletions with the luciferase reporter gene enabled the identification of potential sites on the promoter to which regulating proteins may bind. Specific regions identified by quantification of reporter gene expression were further analyzed by electromobility gel shift assays (EMSA). A protein found to specifically bind to a 30 bp probe approximately 230 bp upstream from the transcription start site was isolated by a series of chromatography techniques. The highest sequence similarity found to this protein was with folic acid synthase.

EXPRESSION AND REGULATION OF ALKALINE PHOSPHATASE DURING DEVELOPMENT OF *DICTYOSTELIUM*. Brad Joyce, M. Ubeidat, C. Eristi, N. Wiles, and C.L. Rutherford, Biol. Dept., Va. Tech, Blacksburg VA 24061. Alkaline phosphatase (ALP) may play a vital role in the development of *Dictyostelium* because during development it becomes localized to a narrow band at the interface of the prestalk and prespore zones. We amplified 880 base pairs of the *alp* 5' flanking region from genomic DNA and fused it to a *LacZ* reporter gene. *In situ* -galactosidase assays of *Dictyostelium* transformants showed a localization pattern that correlated well with authentic ALP activity.  $\beta$ -galactosidase assays of transformants containing the full-length *alp* promoter fused with the *lacZ* gene showed a steady increase in activity until mid culmination stage, then decreased slightly in late culminants and mature fruiting body structures. Transcription start site mapping indicated a single transcription start site 144 nucleotides upstream of the start codon. A potential TATA box domain was present beginning at -29 and ending at -24. 5' Promoter deletion analysis of the *alp* 5' flanking region indicated the presence of a novel *cis*-acting element between -787 and -517. Preliminary internal deletion analysis of this region suggested a transcription factor binding domain between -642 and -574.

UNDERSTANDING THE FUNCTIONAL SIGNIFICANCE OF CONSERVED SEQUENCE MOTIFS IN THE *ARABIDOPSIS* HEXOSE TRANSPORTER, STP1. J.C. Daniel, Dept. of Biol., James Madison Univ., Harrisonburg, VA 22807. The hexose transporters of *Arabidopsis thaliana* belong to a superfamily of proteins called major facilitator proteins, which have been identified in humans, plants and yeast. These proteins share a common predicted secondary structure which includes 12 transmembrane-spanning alpha-helices (TMD), internal N- and C-termini, a long extracellular loop between TMD 1 and 2, and a large intracellular loop between TMD 6 and 7. In each species studied so far, multiple genes which encode hexose transporters have been identified. In addition, hexose transporters have been found to transport varying substrates with varying kinetics. Therefore, the group of transporters is thought to enable the metabolism of sugars according to organism-specific internal and external environmental conditions. Our hypothesis is that amino acid sequence motifs can be identified which confer the functional diversity seen in this class of proteins. In this preliminary study, we have identified several possible amino acid sequence motifs which may play a role in the function of the *Arabidopsis thaliana* hexose transporter, STP1. We also propose to elucidate the role that these amino acid sequence motifs play in determining the function of hexose transporters.

COMPARISON OF DRAWINGS AND PLASTER CASTS OF FISH CARVINGS FROM THE PUNT RELIEF FROM THE TEMPLE OF HATSHEPSUT AT DEIR EL-BAHARI. Emily Lord, Departments of Biology and Art History, Randolph-Macon College, Ashland, VA 23005 and Eugene Maurakis, Science Museum of Virginia, 2500 W. Broad St., Richmond VA 23220. Objectives of this study were to document the differences between image characteristics of the two sources (illustrations in Naville, 1898; images in cast of relief at Virginia Museum of Fine Arts, VMFA) of the Punt relief from the temple of Hatshepsut at Deir El-Bahri, and to identify species depicted therein. Characteristics of 30 species in illustrations were described and compared to descriptions made of the corresponding 30 species photographed from the cast at VMFA. Number of differences and similarities were recorded for each pair of corresponding icons and used to calculate percent difference hypothesized to be zero. Compared to cast images, all illustrations in Naville (1898) contained errors. Average number of errors between cast images and illustrations was 4.1 ( 1.96) or 42.8% ( 18.8) (range = 1-8 or 14.3% - 88.9%). Over 76% of the illustrations had three or more errors. As a result, we reject the hypothesis that there are no differences between illustrations of made by Naville in 1898 and photographs of aquatic species on Punt relief from the Temple of Hatshepsut at Deir El-Bahari.

AN EVALUATION OF THE MOST PREDICTIVE BIOASSESSMENT INDICATORS IN THE IDENTIFICATION OF ACTIVE AND ABANDONED MINE LAND IMPACTS IN SUBWATERSHEDS OF THE POWELL RIVER, SOUTHWESTERN VIRGINIA. B.S. Echols<sup>1</sup>, R.J. Currie<sup>1</sup>, D.S. Cherry<sup>2</sup>, & J.M. Uerz<sup>2</sup>. <sup>1</sup>Dept. of Biol., Roanoke Coll., Salem, VA 24153 and <sup>2</sup>Dept. of Biol., Va. Polytechnic Inst. & State Univ., Blacksburg VA 24061. An integrative bioassessment conducted from spring 2002-spring 2003 was used to determine the influences of Active Mining and Acid Mine Drainage (AMD) on the Powell River. Assessments were conducted on a subwatershed scale and included streams and tributaries in the Looney Creek, Pigeon Creek, Crab Orchard, Jordan's Branch, Well's Branch, Bundy Creek and North Fork Powell River subwatersheds. Bioassessment included acute (48 hr) water column tests with *Ceriodaphnia dubia*, chronic (10 day) sediment tests with *Daphnia magna*, sediment metals analyses (Cu, Mn, Fe, Zn, Al), *in situ* (30 day) Asian clam tests, habitat assessments and benthic macroinvertebrate surveys. Acute water column toxicity tests and habitat assessments did not predict instream impacts from active mines or AMD. Sediment toxicity tests and *in situ* tests were most variable, while benthic macroinvertebrate surveys (taxa richness, % Ephemeroptera, Ephemeroptera-Plecoptera-Trichoptera) were determined to be most reliable.

THE EFFECTS OF DIFFERENT MEDIA ON GROWTH AND CELL DIFFERENTIATION IN THE CYANOBACTERIUM *ANABAENA AZOLLAE*. M. Brown and R. Fisher, Dept of Biology, VCU. Richmond VA 23284. Our objective was to determine if media variations would make a considerable difference in chlorophyll-a concentrations and the number of heterocysts found in the cyanobacterium, *Anabaena azollae*. *A. azollae* was isolated from *Azolla mexicana* ferns, maintained in a 8-fold dilution of the medium AA/8 at 25±3 Celsius. *Anabaena* was cultured under two conditions: 5 ml of a 7 day old control stock in AA/8 medium and 5 ml of a 7 day old control stock in SSM medium which lacks phosphorus. The results of this experiment indicate that even though the chlorophyll-a concentration levels increased in both media during a 21 day growth cycle, there was a 30% increase in the chlorophyll-a concentration in samples grown in the AA/8 medium. The percentage of heterocysts indicated also that AA/8 medium provided a heterocyst rich environment that decreased over the 21-day growth cycle. The SSM cultures developed very few heterocysts and by the end of the 21 day period there was only a 1% average of heterocysts to akinetes in the sample. The results show that the type of medium does make a difference in the percentage of heterocysts and the chlorophyll-a concentrations (Supported by the National Science Foundation).

THE EFFECT OF SODIUM NITRATE ON GROWTH AND CELL DIFFERENTIATION IN THE CYANOBACTERIUM *ANABAENA*. J. Clanton<sup>1</sup> & R. Fisher<sup>2</sup>, <sup>1</sup>Sciences, J. Sargeant Reynolds Community College, Richmond VA 23219 and <sup>2</sup>Dept. of Biology, Virginia Commonwealth Univ., Richmond, VA 23284. This project evaluated the effects of sodium nitrate on the growth and differentiation of the cyanobacteria *Anabaena azollae*. Cyanobacteria use heterocysts to fix atmospheric nitrogen. Studying this organism allows us to evaluate cell differentiation and its effects on a larger system. All cultures were grown in 75 ml of AA/8 medium contained in 125 ml flasks. Two milliliters of sub-culture were transferred weekly into new flasks to maintain a stock. All experiments were done in triplicate & repeated three times. Heterocyst counts were taken in both control and experimental cultures over a fourteen day period. Growth was monitored as a change in chlorophyll concentration. Both chlorophyll and heterocysts declined in sodium nitrate treated cultures, indicating that added nitrogen inhibited heterocyst development. Cyanobacteria no longer had to fix their own nitrogen and stopped the differentiation of vegetative cells into heterocysts. These processes in conjunction showed a direct correlation between the presence of heterocysts and a healthy growing system. This illustrates the impact a single factor can have on a biological system.

CHANGES IN CHLOROPHYLL AND PHYCOBILIPROTEIN BIOSYNTHESIS IN THE CYANOBACTERIUM *ANABAENA AZOLLAE* AS INFLUENCED BY LIGHT AND FRUCTOSE. Tina A. R. Smith<sup>1</sup>, & R. Fisher<sup>2</sup>, <sup>1</sup>Sciences, J. Sargeant Reynolds Community College, Richmond VA 23227 and <sup>2</sup>Dept. of Biol., Virginia Commonwealth Univ., Richmond VA 23284. The purpose of this project was to study the effects of various light and nutrient conditions on phycobiliprotein and chlorophyll a biosynthesis in the cyanobacterium *Anabaena azollae*. Conditions included: AA/8 medium in the light; AA/8 medium in the dark; AA/8 medium plus fructose in the light; and AA/8 medium plus fructose in the dark. All experiments were run in triplicate and repeated three times. Phycobiliprotein (Phy) and chlorophyll a (Chl) were extracted and quantified using a Varian DMS UV Visible spectrophotometer. The cultures grown in the dark with fructose did grow without the present of light. The results were that the cultures with fructose grown in the dark did not grow as well as the cultures in the light but maintained a similar Phy/Chl ratio. Cultures grown in the dark without fructose had a reduced phycocyanin concentration but had an increased allophycocyanin (APC) and phycoerythrin (PE) ratio. This could be because the *Anabaena azollae* was trying to adapt to its environment and by doing so increase its levels of APC and PE.

THE DEVELOPMENT OF A MODIFIED OSMOTIC FRAGILITY TEST TO EXAMINE THE EFFECTS OF COMPOUNDS ON THE OSMOTIC PERMEABILITY PATHWAY IN BOVINE ERYTHROCYTES. G. J. Seeba and S. Gallik, Dept of Biol., Mary Washington Coll., Fredericksburg, VA 22401. Previous reports have demonstrated that mercurial agents reduce the conductance of water through the aquaporin-based osmotic permeability pathway (OPP) of red cells. Three versions of the osmotic fragility test, the standard osmotic fragility test and two variations of the test, were used in this study to determine whether these simple assays can be used to study the effects of mercurial compounds on the OPP of red cells. Results from each test consistently showed that 0.125mM HgCl<sub>2</sub> significantly enhances the conductance of water through the osmotic permeability pathway of bovine red cells. While these results differ from the results of most previous studies, which show that HgCl<sub>2</sub> reduces water flow through the OPP, the results of this study show that all three osmotic fragility tests are sensitive enough to show the effects of HgCl<sub>2</sub> on the OPP of red cells, at least at the concentration used here.

THE EFFECT OF TETRAETHYLAMMONIUM ON THE AQUAPORIN-DEPENDENT OSMOTIC PERMEABILITY PATHWAY IN BOVINE ERYTHROCYTES. K.R. Hitz and S. Gallik, Dept of Biol., Mary Washington Coll., Fredericksburg, VA 22401. Tetraethylammonium chloride (TEA) is a known ion channel blocker shown to block the aquaporin-1-based osmotic permeability pathway (OPP) in oocytes and renal epithelial cells. The objective of this study was to test the potency of TEA on the aquaporin-based osmotic permeability pathway in bovine red blood cells using three versions of the osmotic fragility test. Results of each test consistently showed that 100 mM TEA decreased the percentage of red cells hemolyzed when exposed to hypotonic balanced salt solutions of 0.45% and 0.5% NaCl osmotic equivalence. Since osmotic permeability is the basis for this hemolysis, we interpret this decrease in percent hemolysis as a decrease in the osmotic permeability of the red cell plasma membrane. The results of this study also confirmed the results of others that the three osmotic fragility tests used here can be used to study the effects of reagents on the OPP of red cells.

### Biomedical and General Engineering

CHARACTERIZATION OF ELECTROCONDUCTIVE ppy-p(HEMA) COMPOSITE HYDROGELS FOR SENSING APPLICATIONS. Sean Brahim and Anthony Guiseppi-Elie, Center for Bioelectronics, Biosensors and Biochips (C3B), Virginia Commonwealth University, Richmond, Virginia 23284-3038. We have formed composites of inherently conductive polypyrrole (PPy) within highly hydrophilic poly(hydroxyethyl methacrylate) [p(HEMA)]-based hydrogels. These materials retain the hydration characteristics of hydrogels as well as the electroactivity and electronic conductivity of CEPs and are thus called 'electroconductive hydrogels'. The electrical and electrochemical properties of these polymer composites have been investigated. The electrochemical characteristics observed by cyclic voltammetry suggest less facile reduction of PPy within the composite hydrogel compared to electropolymerized PPy, as shown by the shift in the reduction peak potential from -472 mV for electropolymerized polypyrrole to -636 mV for the electroconductive composite gel. The network impedance magnitude for the electroconductive hydrogel remains quite low, ca. 100 Ohms, even upon approach to DC, over all frequencies and at all offset potentials suggesting retained electronic (bipolaronic) conductivity within the composite. The loss of electroactivity after extensive oxidation of the composite material is a phenomenon that suggests an inherent change in the backbone structure of the polypyrrole component; a likely disruption of conjugation throughout the PPy backbone.

BIOPRODUCTION OF FERULIC ACID FROM PLANT CELL WALL MATERIAL. Kennard M. Brunson and Rachel Chen, Dept. of Chemical Engineering, Virginia Commonwealth University, Richmond, VA. This work is part of an ongoing project to find an environmentally friendly or "green" process for synthesizing ferulic acid, a precursor to vanillin which is used in the flavoring of food. This important precursor molecule is attached via ester bonds to the xylan chains of plant cell wall material such as corn bran and oat spelt, which can be broken by using ferulic acid esterase (FAE). At this point three fungal species, *Aspergillus niger* NRRL 3, *Aspergillus flavus* NRRL 3518 and *Aspergillus flavus* NRRL 4998 were grown on oat spelt xylan for 4 days to induce the production of ferulic acid esterase. The supernatant of the growth medium was then incubated in a 100uM solution of methyl ferulate and analyzed by UV-Vis spectroscopy. Of these three strains only *Aspergillus niger* NRRL 3 had definitive results indicating that ferulic acid was produced with a 54.7% conversion of methyl ferulate on day 2, its peak day of growth, and an enzyme activity of 10.9mU/mL of supernatant.

PC12 CELL MOTILITY AND ADHESION MONITORING USING MICROELECTRODE ARRAYS, G. Slaughter<sup>1</sup>, E. Bieberich<sup>2</sup> and A. Guiseppi-Elie<sup>1</sup>, <sup>1</sup>Dept of Chemical Engineering and Center for Bioelectronics, Biosensors and Biochips, VCU and <sup>2</sup>Medical College of Georgia. The development of cell-based biosensors in our laboratory is directed to detecting the effects of several chemical welfare stimulants on the central nervous system. The sensing systems developed are based on pheochromocytoma cells, PC12, that have properties associated with immature neural crest cells that are destined to evolve into adrenal gland chromaffin cells or sympathetic neurons. These neuron-like cells are capable of generating processes from their cell body upon attachments to adhesion substrates. However, in the presence of specific trophic substances, or hormones, the cells undergo differentiation, which results in the cessation of proliferation. Currently, we use a microelectrode array system for measuring the change in electrical impedance of a small electrode to AC current upon seeding the cells into individual wells. There are many compounds of interest to bio-chemical welfare research. We are interested in those molecules that bind to cell surface receptors and affect the functionality of the CNS when the receptor receives these ligands. As a result of binding, changes in a signal transduction pathway are observed due to the enhancement or reduction of the cellular response. Through the use of a time course monitoring of cellular response, we can avoid many potential false positives that occurs with the assays that are concerned with binding.

CHARACTERIZATION OF ALIGNED CARBON NANOTUBE POLYMER COMPOSITES. S.Banda<sup>1</sup>, Z.Ounaies<sup>1</sup>, C.Park<sup>2</sup> and J.Wilkinson<sup>3</sup>, <sup>1</sup>Virginia Commonwealth University, <sup>2</sup>National Institute of Aerospace, <sup>3</sup>Virginia Polytechnic Institute and State University. Carbon nanotubes (CNTs) may be aligned by applying an electric or magnetic field, or by mechanical stretching. This project focuses on characterization of an electric field aligned CNT/ UDMA/HDDMA polymer composite. An ac field of  $200V_{pp}$  at various frequencies (10 Hz, 10 KHz, and 100 KHz) was applied for 10 min at room temperature. Conductivity measurements were done parallel and perpendicular to the aligned CNTs. It was observed that the conductivity of the 10KHz and 100KHz cases was higher than the 10Hz case in both the parallel and perpendicular conditions. Conductivity in the parallel condition was higher than the perpendicular condition for all the aligned cases, while the unaligned case showed a similar conductivity in both conditions. A ratio of parallel to perpendicular conductivity indicates a better alignment for the 10 Hz case. Using the polarizer light in Raman spectroscopy, the tangential peak of the CNTs was investigated. The results for the unaligned case did not show a preferential direction, whereas the aligned cases indicate a preferred aligned direction. A good alignment of the CNTs in the polymer was achieved as evidenced by conductivity measurement and Raman spectroscopy. Future work will concentrate on varying the CNT content and further investigation of frequency and field effects.

PVDF: THE PERFECT POLYMER FOR PIEZOELECTRIC PERFORMANCE IN PEOPLE? C. P. Barnes<sup>1</sup>, Z. Ounaies<sup>1</sup>, W. D. Bates<sup>2</sup> and G. E. Wnek<sup>2</sup>, <sup>1</sup>Department of Mechanical Engineering and <sup>2</sup>Department of Chemical Engineering, Virginia Commonwealth University, Richmond VA 23284. Piezoelectric polyvinylidene fluoride (PVDF) has been used in intracorporeal biomedical applications including vascular grafts, nerve guidance channels, and bone-growth stimulation devices. The degree and type of crystallinity, as well as molecular orientation, are greatly responsible for the desirable properties displayed in PVDF; for piezoelectric studies, the crystalline  $\beta$ -phase is the most desirable. The electrospinning technique was used to deposit thin PVDF films. Effects of solvent type and electric field strength were monitored and analyzed. Characterization methods included x-ray diffraction, differential scanning calorimetry, dielectric spectroscopy, and thermally stimulated current analysis. Films sprayed at 1 kV/cm were mostly amorphous, while those at 2 kV/cm and 4 kV/cm displayed predominantly  $\beta$ -phase. The dielectric constant of each film at room temperature was greater than the corresponding value of unpoled PVDF film. Charge relaxation was detected in all electrospun films, though the magnitude was less than that observed in commercial PVDF film. Future work will include using higher electric fields and adding nucleation sites to potentially enhance  $\beta$ -phase growth.

AGE AND TASK DEPENDANT VARIATIONS IN PRE-MOTOR POTENTIALS IN THE BRAIN. Vishwadeep Ahluwalia, Peter Lum, Ding-Yu Fei, Department of Biomedical Engineering and Stephen Harkins, Department of Gerontology, Virginia Commonwealth University, Richmond, VA. The purpose of this study was to investigate the dependency of premotor potentials of the brain on age and task. Eight healthy volunteers participated in this study. The subjects were classified into two categories: young and old. Each subject was asked to perform tasks like isometric elbow-flexion, pick and place task and reaction time tasks. Thirty to 40 trials were recorded for each of the above tasks. EEG signals were recorded from the scalp overlying the supplementary motor area (SMA) and EMG signals were recorded from the skin surface overlying the belly of the biceps brachii and brachioradialis muscles during all contractions. In each trial, the EMG onset was used as the triggering signal for EEG averaging. Premotor potential amplitude was measured from the beginning to the peak of the negative slope. The magnitude of the negative slope from the SMA location was highly correlated with the age of the subject and task executed by the subject. These results suggest that premotor potentials are age and task dependant.

EFFECT OF PARKINSON'S DISEASE ON EYE AND HEAD MOVEMENTS DURING READING. P. Puthoor, K. Peters and P. A. Wetzel, Dept of Biomedical Engineering, VCU. The oculomotor system's main function is to position the eyes such that the maximum amount of visual information can be extracted from the object of interest. Parkinson's patients suffer significantly more from impaired oculomotor function, i.e. visual discomfort, diplopia, blurry vision, than non-Parkinson's patients. Symptoms of Parkinson's disease can be attributed to reduced dopamine levels. The study's intention was to determine the effects of Parkinson's on reading. During reading, there is a sequence of eye movements that can be quantified. An eye and head tracker system was used to obtain the eye and head positions while reading text. Measurements of interest include the number and duration of fixations, regressions, and saccade latencies. The effects of Parkinson's disease on reading have not previously been established, and preliminary data is still being gathered. Difficulty was encountered when attempting to quantify the data because of discrepancies appearing due to tremor of the eye and head. Fixation time and number of regressions appear to be higher for Parkinson's patients than for non-Parkinson's patients. A greater number of subjects must be studied in order to fully postulate the effects of Parkinson's disease on reading.

NON-PARAMETRIC ANALYSIS OF THE ANKLE JOINT IN INVERSION EVERSION. S. Russell, G. Kauffman & K. Granata, ESM Virginia Tech. Most ankle injuries occur too quickly for reflex or higher level motor control to actively increase the stiffness of the joint by increasing muscle activation. The passive stiffness of the ankle joint contributes significantly to stability in both static and dynamic situations. Several subjects were asked to stand on a cradle which was perturbed via a servo motor in the directions of inversion eversion. The ankle position and the torque applied via the motor were collected and used in the analysis. Three cases were studied, one normal stance (zero moment), plantarflexion moment applied, dorsiflexion moment. The analysis was designed to verify that activation of muscles for planter/dorsiflexion increase the rotational stiffness of the ankle in the inversion eversion directions. The increase plantarflexion and dorsiflexion resulted in a significant increase ( $p < 0.05$ ) in the natural frequency. Based on this we can conclude that the inversion/eversion stiffness of the ankle has increased with plantar/dorsiflexion moment. Results suggest plantarflexion moments as in walking or running may help to stabilize the ankle against inversion injury.

PARAMETRIC EVALUATION OF ANKLE IN INVERSION-EVERSION, S. Russell and K. Granata, Engineering Science and Mechanics Dept, Virginia Tech. Active joint torques are the primary source of power and control in dynamic walking motion. However the amplitude, rate, timing and phasic behavior of the joint torques necessary to achieve natural and stable performance are difficult to establish. The developed control of active joint torques resulted in a smooth and gradual application of energy to the system throughout the gait cycle. Previous models have assumed energy input was impulsive, i.e. short bursts of energy, despite human data that illustrates power

consumption is smooth and continuous. Results from this model suggest that most of the torque necessary for walking is applied at the ankle joint agreeing with human data indicating push-off is a primary energy source for walking. However, because there were neither feet nor extensible legs the model predicted unrealistic dorsal flexion moments. To permit improved realism and pathologic modeling future studies will expand the model to include knee and ankle joints. A simple linearized version of the previously developed virtual slope control is developed and implemented resulting in stable controlled gait patterns.

**PROPRIOCEPTIVE AND LOWER EXTREMITY TORQUE CHANGES FOLLOWING ANKLE SPRAIN.** P.E. Pidcoe, Department of Physical Therapy, Virginia Commonwealth University, Richmond, VA. Purpose: To evaluate weight-bearing (WB) performance following ankle sprain and the effect of a proprioceptive taping intervention. Methods: Subject was a 27 yo male 2-days post ankle sprain requiring no hospital treatment. Kinematic and kinetic data were collected weekly as the subject performed balance and single leg landing tasks. Analysis: Lower extremity (LE) joint torques during landing and sway area during balance tasks were computed. Percent changes from baseline were evaluated. Results: Week 0 injured-ankle joint torque was diminished. By week 9, LE joint torque on the injured side resembled the uninvolved side. Sway area increased to 160% by week 3 and then decrease progressively to 62% below baseline by week 9. Proprioceptive taping increased injured-ankle peak torque and decreased sway area by 50%. Conclusion: The post-injury increase in proximal joint torque during landing implies a proximal control strategy to decrease stress on the injured joint. Balance declined prior to improvement by week 9, implying proprioceptive change is not directly linked to landing performance change. Taping improved balance and landing performance, suggesting increased afferent gain.

**MECHANICAL ENERGY MEASURES DURING UNSTABLE PLATFORM STEP-UP ACTIVITIES.** Pidcoe, P.E., Burnet, E.N. and Carpenter, M.T., Department of Physical Therapy, Virginia Commonwealth University, Richmond, VA. Purpose: To determine if energy expenditure differences exist during the performance of a repetitive stepping activity under a variety of controlled stability conditions. Methods: Thirty subjects (20-40 yo) with no history of balance problems were instructed to perform a cyclical self-paced stepping activity onto a 6-inch high labile platform (Reebok CORE Board) for nine 5-second trials. The trials used combinations of 3 board stiffness settings and 3-foot positions. Segment motion data, ground reaction force data, and LE EMG data were digitally sampled. Analysis: Step cycles were determined via force data and segment motion data was used to compute per-step-cycle total mechanical energy (translational kinetic + rotational kinetic + potential). Step cycle EMG data was filtered and processed with an RMS algorithm using a 40ms time constant. Energy and EMG data were normalized by total step cycle time. Results: LE EMG and mechanical energy requirements increased as a function of increased foot width and decreased platform stiffness. This change was statistically significant (0.05 level) for the most unstable platform setting and the widest foot position trials. Conclusion: Controlling these variables in an exercise protocol may be an effective way to progress the activity and place higher demands on postural control mechanisms. FUNDING SOURCE: Reebok, Inc. (June 2002).

**TRANSVERSELY ISOTROPIC BEHAVIOR OF ARTICULAR CARTILAGE-A FINITE ELEMENT STUDY.** Michael J Araj and Jennifer S. Wayne, Orthopaedic Research Laboratory, Departments of Biomedical Engineering and Orthopaedic Surgery, Virginia Commonwealth Univ., Richmond, VA 23298-0694. Articular cartilage is a resilient load bearing anisotropic tissue whose unique structural organization and compositional makeup endow it with the ability to help lubricate joints and distribute loads over joint surfaces. The mechanical behavior of cartilage has been modeled with finite element (FE) analysis to give greater insight into the tissue's function. Our prior study indicated that FE modelling of cartilage as an isotropic material (i.e. same material behavior in all coordinate directions) did not accurately represent the organizational structure of the collagen fibrils, thus leading to discrepancies between FE predictions and experimental results. In this study, ABAQUS® was used to model articular cartilage as a transversely isotropic material which mimicked

the preferred orientation of collagen fibrils in the tissue's superficial tangential zone. This model was then subjected to an aspiration pressure, simulating the experimental configuration of a new testing technique being developed by our laboratory. FE predictions with this new model will be more reflective of the tissue's true mechanical behavior.

FINITE ELEMENT ANALYSIS OF BONE FIXATION CONSTRUCTS. John R. Owen<sup>1</sup>, and Jennifer S. Wayne<sup>1,2</sup> <sup>1</sup>Department of Orthopaedic Surgery, and <sup>2</sup>Department of Biomedical Engineering, Virginia Commonwealth University, Richmond, VA 23298. Finite element analysis (FEA) is an important analytical tool for predicting the outcome of orthopaedic procedures. Predicting the strength of femoral allograft struts, used for bone stock augmentation, is one example where FEA can be useful. This study models three point bending of femoral allograft struts using SolidWorks software to build the geometric models, ABAQUS software to perform the FEA, and comparison to experimental data for validation. Using limited physical measurements, recorded during a previous experimental biomechanical study, geometries were approximated for five femoral struts. A range of material properties was approximated from the literature. The strut models were "loaded" in ABAQUS at a rate of 0.5mm/sec. Experimental specimen stiffnesses fell to the low end of assumed material properties in the FEA. However, the models correctly predicted that the posterior struts would be stiffer than anterior struts, and generally predicted the ranking of stiffnesses among the experimental specimens (low to high). This study illustrates the power of FEA in predicting trends and relative differences, even with limited geometric and material property data.

REDESIGN OF A TRACTION SYSTEM USING 3-D SOLID MODELING AND FINITE ELEMENT ANALYSIS. S. Sell and J.S. Wayne, Dept. of Biomedical Engineering, Virginia Commonwealth University. The McCarthy Hip Distractor, manufactured by Innomed Inc., is a hip distraction kit often used for hip arthroscopy procedures. This kit consists of a stainless steel bed frame, a foam padded groin stabilizer, a threaded distraction rod, and a form fitting polymer boot. However, this design had several glaring issues that needed to be addressed, and these issues served as the basis for this project. The frame and groin stabilizer lacked flexibility in their design and required that the patient be positioned laterally on the operating table. In addition, the frame was unable to provide any sort of adjustment to accommodate tall patients. The polymer boot tended to cause a forced plantarflexion when loaded, ultimately leading to the boot slipping down the leg of the patient and causing tissue damage. The Innomed design also lacked any sort of device for measuring the load applied to the leg. Redesign was performed with the Solidworks 3-D modeling program and the COSMOS FEA program. A frame was designed that allowed for use in either supine / lateral positions and had the ability to accommodate patients of all sizes. The groin stabilizer was also designed for use in either supine / lateral position. A boot model was designed that reduced the forced plantarflexion. The effectiveness of the boot and frame models was verified by the FEA results. A load measurement device (parallel spring / LVDT) was also modeled using Solidworks, in hopes of establishing hip distraction displacement guidelines.

BONE MARROW DERIVED MESENCHYMAL STEM CELL SEEDING OF PLA SCAFFOLDS. K. J. Shields, C. L. McDowell, and J. S. Wayne, Orthopaedic Research Laboratory Department of Biomedical Engineering, Virginia Commonwealth University and VA Medical Center, Richmond, VA 23298. The development of a suitable method for biologic repair and replacement of damaged articular cartilage has been a challenging area of orthopaedic research. Through the use of appropriate biomaterials and an adequate cell source it is possible to tissue engineer a scaffold for potential cartilage repair. The current study takes advantage of a foaming process, which creates a porous scaffold of polylactic acid (PLA). Pluripotent mesenchymal stem cells derived from bone marrow were used as the cell source. Placement into a 3D scaffold and under certain culturing conditions the stem cells differentiate into chondrocytes. SEM analysis revealed cellular adherence to the scaffold and the morphology. Histology included both H&E and Safranin-O staining revealing cellular proliferation and proteoglycan production, respectively. Future endeavors include

immunohistochemical analysis to determine cellular products, implantation of the scaffolds into cartilage defects to determine their in vivo capabilities, and mechanical testing of scaffolds through indentation testing to determine their mechanical properties and compare to other articular cartilage repair tissues.

DEVELOPMENT OF A NOVEL ELECTROSTATIC PROCESSING DEVICE FOR TISSUE ENGINEERING APPLICATIONS. Eugene Boland and Gary Bowlin, Dept. of Biomed. Eng., VCU Richmond, VA 23298. The specific aim of this project is to develop an automated electrostatic processing apparatus that is capable of controlling the three-dimensional architecture of an electrospun scaffold. Electrospinning is based upon the simple concept of using charge separation to overcome surface tension. This technique is documented and can be adapted for tissue engineering scaffold production. The next generation electrospinning apparatus to be presented (designed, fabricated, and validated) incorporates multi-axis controls for repeatable scaffold production. Fiber alignment and scaffold density are precisely controlled by rotating a mandrel along one axis, translation along that same axis, and rotation around the second axis perpendicular to the electrospun fiber stream. Through extensive laboratory analysis (mechanical testing and both optical and electron microscopy), parameters such as fiber orientation, diameter and mechanics will be predictive from specific polymer setups. Our laboratory has demonstrated the ability to electrospin natural and synthetic polymers and this will be incorporated into the electrospinning apparatus to tailor scaffolds to meet specific tissue engineering needs by creating a truly biomimicking scaffold/ extracellular matrix.

DOES THE DIAPHRAGM MOTION FOLLOW A NORMAL DISTRIBUTION? IMPLICATION FOR RADIATION TREATMENT PLANNING FOR LIVER AND LOWER LOBE LUNG CANCER PATIENTS. Rohini George, Paul J. Keall, Vijay R. Kini<sup>2</sup>, Sastry. S. Vedam<sup>2</sup>, Viswanathan Ramakrishnan, Virginia Commonwealth University, Richmond, VA 23298. Radiation therapy planning involves the addition of margins to tumor volume. This margin is composed of the set-up margin and the internal margin. Set-up error (S) is assumed to be a normal distribution while the diaphragm motion (R), which is the internal motion for liver and lower lobe lung cancer patients, is not a normal distribution. The rationale for this study if the following conditions are met, it is correct to use quadrature summation: (1) R convolved with S is normal and (2) standard deviation of total error is the quadrature sum of standard deviations of R and S. Sixty fluoroscopy datasets for five patients acquired over five sessions were analyzed to obtain diaphragm motion. The diaphragm motion datasets that did not initially have normal distributions were convolved with a normal signal representing set-up error (S). We determined the standard deviation of set-up error for which convolution of diaphragm motion and set-up error was approximately normal. For most treatment planning purposes diaphragm motion and set-up error can be added in quadrature to obtain the margin for the tumor volume.

WHERE FAST FOURIER TRANSFORM FAILS – A COMMON MISUSE OF FREQUENCY ANALYSIS ON CARDIAC SIGNALS AND IMPACT ON MECHANISM OF VENTRICULAR FIBRILLATION. Suresh E. Joel and Peng-Wie Hsia, Dept. of Biomedical Engineering, Virginia Commonwealth University, Richmond, VA 23298-0694. Distribution of excitation frequencies underlying ventricular fibrillation (VF) has been explored with fast Fourier transform (FFT) technique. Specifically, “discrete” dominant frequency (DF) domains on the heart surface have been discovered and used to support certain mechanism of fibrillation. We applied zero-padded FFT (ZP-FFT) to improve the accuracy of DF measurements in short VF segments. It is shown that the accuracy of DF measurement is limited using traditional FFT when the inherent frequency resolution is inadequate. The detection error of DF measurement could be either confined by the frequency resolution or at times greater than the resolution itself if the spectrum has multiple peaks. To highlight

the potential impact on the validity of the proposed mechanism of fibrillation, we demonstrated that the claimed “discrete” DF domains might no longer be valid in some cases if the ZP-FFT were utilized to generate the high-precision (HP) DF map. However some DF domain boundaries persisted. Our results suggest that the HPDF map analysis maybe more suitable in VF mechanism studies.

**DYSARTHIC ISOLATED SPEECH RECOGNITION-A NEURAL NETWORK APPROACH.** Prasad D Polur and Gerald E Miller, Department of Biomedical Engineering, Virginia Commonwealth University, Richmond VA 23284-0694. This work examines application of artificial neural networks (ANN) towards creating a small vocabulary, isolated and speaker dependent speech recognition system, specifically related to dysarthric (cerebral palsy) speech. A small size vocabulary spoken by three cerebral palsy subjects is chosen. The spectral features like Mel frequency cepstral coefficients (MFCC) and energy coefficients are extracted per frame and fed as input elements to a multiple ANN system. These networks have a feed forward architecture and use the backpropagation with momentum algorithm (for training/adjustment of weights). The output of this network is a category sequence, which is loaded into a pattern search function that matches the input sequence with a set of target word patterns, in order to determine the ‘most likely’ uttered word. By embedding singular training files in the multiple ANN system during its training cycle the performance of the network was enhanced to > 80%. The level of variability in input dysarthric speech patterns (per speaker) limits the vocabulary and to some extent, the reliability of the ANN, however its application seems to hold sufficient promise, offering both efficiency and robustness.

**APPLICATION OF NEURAL NETWORKS TO SPEECH RECOGNITION USING MINIMAL PRE-PROCESSING.** Grace M. Ferguson and Rosalyn S. Hobson, Dept. of Electrical Engineering, Virginia Commonwealth Univ., Richmond VA. 23284. Pre-processing has been considered to be integral part of speech recognition when using neural networks; however, pre-processing is time-consuming and the computer code for pre-processing methods can be more complex than the neural network speech recognition code. Earlier work has shown that a neural network system with minimal pre-processing can recognize a small sample set with 100% accuracy; this research was expanded by increasing the sample size to 10 different words. Three different neural network structures (a back-propagation feed-forward network, a Kohonen self-organizing map, and a radial basis function network) are trained and tested with this data set. Although both the back-propagation and radial basis function neural networks could train with 100% accuracy, neither could recognize untrained words with any significant level of recognition. The back-propagation neural network could recognize untrained words with 15% accuracy, and neither the Kohonen network nor the radial basis function network could recognize untrained words. The results do not show an adequate level of recognition from any of the networks to state that speech recognition with minimal pre-processing is viable.

**A COUPLED MODEL FOR PREDICTING HEAT AND MASS TRANSFER FROM A HUMAN BODY TO ITS SURROUNDINGS.** Ahmed AL-Mogbel, Department of Mechanical Engineering, College of Engineering, Old Dominion University, Norfolk, VA 23529, USA. Prediction of heat and mass transfer from the human body requires an accurate 3-dimensional model of the body and the interaction between the body and its surroundings. The characterization of heat and moisture transfer between the body and its surroundings can affect the microclimate around the body as well as the human sensation of heat. Similarly, the microclimate surrounding the body can also significantly affect the local heat transfer characteristics of that body. Two numerical methods were combined to characterize the thermal environment around a human body, which considered body surface temperature as well as heat and mass balance equations. Results were obtained for several metabolic rates, and different vent air velocities including room temperatures that were used to map the region of thermal comfort and discomfort.

TIMID ABOUT POLYIMIDE? David Callahan<sup>1</sup>, Jared A. Rud<sup>1</sup>, Zoubeida Ounaies<sup>1</sup>, Tyler St.Clair<sup>2</sup> and Cheol Park<sup>3</sup>, <sup>1</sup>Electroactive Materials Characterization Laboratory, School of Engineering, Virginia Commonwealth University, <sup>2</sup>Department of Chemistry, Mary Washington College, and <sup>3</sup>National Institute of Aerospace. Aerospace applications require high thermal, mechanical, and chemical stability. Towards that end, polyimide polymers with carbon nanotube (CNT) inclusions were investigated for use in aircraft and spacecraft. A nitrile pendant to the main chain of the polyimide generates a piezoelectric behavior. Both film and fiber forms were examined. CNT-Polyimide composite films showed superior dielectric and electrical properties as compared to the pristine polymer. The dielectric constant and conductivity of the composites improved greatly, reaching percolation at only 0.1wt% and 0.06wt% CNT, respectively. In addition to the increase in the dielectric constant, the dielectric relaxation strength was enhanced, indicating an increase in the piezoelectric behavior with CNT inclusions. Electrospun nanofibers are studied for their lightweight, high surface to volume ratio, and flexibility. Polyimide-CNT fibers were isolated and electroded. Conductivity and dielectric measurements are on going. Further exploration into processing and testing of both films and fibers is continuing to explore repeatability and investigate effects of frequency and temperature.

DETECTION AND MONITORING OF DNA HYBRIDIZATION USING QUARTZ CRYSTAL MICROBALANCE AND IMPEDANCE-BASED TECHNIQUES, Tin Christopher Hang and Anthony Guiseppi-Elie, In the present work, we report on the surface processes and chemistries that are necessary to prepare electrodes as substrates for DNA hybridization. We are concerned with the study of immobilizing 30-mer single stranded DNA (ssDNA) probes onto quartz crystal oscillators and monitoring hybridization with the complementary target sequences for the development of a piezoelectric DNA diagnostic sensor. Furthermore, electrochemical impedance spectroscopy (EIS) is also used to detect and monitor changes in conductivity as a consequence of hybridization. Fourier transform infrared spectroscopy—attenuated total reflectance (FTIR-ATR) is employed to chemically characterize surfaces and to determine changes in surface chemistry, while atomic force microscopy (AFM) is used to examine the topography of these surfaces. Significant changes in electrochemical impedance and mass values were observed as a consequence of epoxy-functionalized surface treatment ( $\Delta m = 271$  ng), immobilization of amine-terminated oligonucleotides, and DNA hybridization upon exposure to its complement (11% increase in impedance modulus at 120 Hz).

ANALYSIS OF HEART RATE VARIABILITY AND OXYGEN CONCENTRATION LEVEL DURING PRETERM INFANT FEEDING, N. A. Fahmy<sup>1</sup>, P.A. Wetzel<sup>1</sup> and R. H. Pickler<sup>2</sup>, <sup>1</sup>Dept of Biomedical Engineering and <sup>2</sup>School of Nursing, VCU. To minimize potential adverse reaction to care-giving activities, bottle-feeding should be provided when the pre-term infant indicates readiness to receive care. Therefore, the primary purpose of this PRO Study is to test a predictive model of bottle-feeding readiness and bottle-feeding outcomes. There are many aspects in bottle-feeding readiness including: the infant's neurological maturation, the severity of illness, and pre-feeding autonomic, motor, and behavioral state organization. On the other hand, bottle-feeding outcomes include: suck-swallow-breathe coordination, feeding performance during and post-feeding autonomic, motor, and behavioral state organization. The secondary purpose of the PRO Study is to examine how bottle-feeding readiness and outcomes are influenced by bottle-feeding experience in an infant. Being able to identify any relationship between suck, swallow, and breathe activities will help in potentially preventing any further delays in the infant's neurological development.

SOUND PRESSURE LEVEL GENERATION AND LIQUID ATOMIZATION IN CONSTANT AND VARIABLE CROSS SECTIONAL RESONATORS. Thaer M. Almasri, and Bart Lipkens, Dept. of Mechanical Engineering, VCU. The main objectives of this work are to investigate the generation of large sound pressure levels (SPL) in standing wave fields in closed cavities (resonators) and the effects of cavity shaping on the SPL and to examine the ability to generate small droplets acoustically (acoustic atomization) in two resonators, one with constant cross sectional area (CCSA)

and one with variable cross sectional area (VCSA). The SPL is measured at the rigid end of the resonators. A SPL of 170 dB is obtained in the CCSA resonator while the VCSA resonator produced a SPL of 175 dB. Liquid atomization is obtained for the same resonators. The results indicate that SPLs exceeding 170 dB are created experimentally in both resonators. SPLs of 159 dB or higher are required for the liquid atomization to start when low viscosity fluid is used. SPLs of 161.8 dB or higher are needed to atomize large viscous fluid.

### Botany

THE *FLORA OF VIRGINIA* PROJECT: A 2002-2003 UPDATE. Marion B. Lobstein, Dept. of Biology, Northern Virginia C.C., Manassas, VA 22205. Virginia, for its landmass, has the most diversity of species of vascular plant of any state in the United States. It had the first flora, the *Flora Virginica* in 1739 yet does not have a modern flora. The Virginia Academy of Science for over fifty years has supported efforts to produce a modern *Flora of Virginia*. In 2001 the Foundation of the Flora of Virginia, Inc, was formed in 2001 and in May 2002 received 501(c) 3 status. Additional members of FFVP Board of Directors have been added to broaden the base of support for this Project. Progress continues to be made on the efforts to develop a Flora of Virginia including fund-raising and public outreach efforts. At the 2002 VAS Annual Meeting a Symposium on the Flora of Virginia was well attended and a similar symposium cosponsored the Foundation of the State Arboretum was held in April 2003 and was a successful fund-raising and public outreach effort. A copy of a 1762 edition of the *Flora Virginica* has been donated to the Project and will be used in fund-raising and public outreach. Work on the content of the Flora of Virginia including the first 150 illustrations have been commissioned, completed, and funded by VAS funds and preliminary work on species descriptions has begun with involvement of the Flora Advisory Board, which includes the membership of the Virginia Flora Committee. The Project efforts to develop a modern *Flora of Virginia* by 2010 have taken root and continue to make substantial progress.

VEGETATION OF NORTH AMERICA – A PICTORIAL JOURNEY. Richard W. Rhoades, 611 Rose Ave. Blacksburg, VA 24060. Plant ecologists generally recognize thirteen ecosystem types or biomes worldwide. These are tropical rainforest, tropical savanna, the atoll, broad sclerophyll vegetation, temperate grassland, warm deserts, cold deserts, temperate deciduous forest, temperate rain forest, montane coniferous forest, boreal coniferous forest, alpine tundra, and arctic tundra. In north America, in the broad sense, 11 of these occur, all except the atoll and tropical savanna. The presentation was illustrated by photos of the major ecosystem types of North America and some less common vegetation types: sand dunes, salt marshes, freshwater aquatic vegetation, and a shale barren.

TOXIC ALGAE IN CHESAPEAKE BAY. Harold G. Marshall, Dept. of Biological Sciences, Old Dominion University, Norfolk, VA. 23529-0266. Since 1985 an extensive phytoplankton monitoring program has been documenting the composition and abundance of taxa in Chesapeake Bay and Virginia tidal tributaries. Marshall (1994, 1996) previously reported over 700 taxa within the Bay, of which 12 species were reported as toxic. More recently this list has expanded to 16 potentially toxic species that have been identified within the Bay system. These include: *Cochlodinium polykrikoides*, *Dinophysis acuminata*, *D. acuta*, *D. caudata*, *D. fortii*, *D. norvegica*, *Karlodinium micrum*, *Lingulodinium polyedrum*, *Pfiesteria piscicida*, *P. shumwayae*, *Prorocentrum minimum*, *Chattonella verruculosa*, *Amphora coffeaeformis*, *Pseudo-nitzschia pungens*, *P. pseudodelicatissima*, and *P. seriata*. In recent years, more extensive blooms of *Karlodinium micrum*, *Dinophysis acuminata*, and *Prorocentrum minimum* have occurred in Bay tributaries. This may indicate a trend and also future concern for their increased abundance occurring and subsequent impact to the region, and for other toxic algae finding Bay and tributary waters favorable to their development. The presence of *Chattonella verruculosa* in Bay waters also represents the broad occurrence of this taxon in U.S. eastern coastal estuaries. (Supported by the Virginia DEQ Chesapeake Bay Monitoring Program).

CONSTRUCTING BOTANICAL WEBSITES USING DATABASES: THE FLORA OF THE SHENANDOAH VALLEY PROJECT. Stephen M. Biscotte, Matthew Hoover, Curtis C. Clevinger, and Jennifer A. Clevinger, Dept. of Biology, James Madison University, Harrisonburg, VA 22807. The Flora of Shenandoah Project is an interactive web-based flora of various locales in the Shenandoah Valley. The website contains road and GPS maps of those locales as well as a searchable database-driven flora with detailed descriptions and digital photographs of each entry. Seventy-five different plant species were digitally photographed over the course of 3 seasons. The database was produced using Filemaker Pro and the site design and maintenance is powered by Dreamweaver MX. This database will serve as an educational resource for several JMU courses including: BIO 386 Field Botany, BIO 486 Systematics of Vascular Plants and BIO 124 Ecology and Evolution Laboratory. Internet Address: <http://csmres.jmu.edu/bioweb/clevingerlab/florashenandoah/>

USE OF ITS rDNA SEQUENCES TO RESOLVE PHYLOGENETIC AND BIOGEOGRAPHIC PATTERNS OF SPECIATION IN THE GENUS *SEMPERVIVUM*. Catherine Hurley & Kevin G. Jones, Dept. of Natural Sciences, The University of Virginia's College at Wise, Wise VA 24293. *Sempervivum* are a genus of succulent alpine plants that are native to mountain ranges from Morocco to Turkey. Species-level distinctions among *Sempervivum* remain obscure. DNA sequences derived from the internal spacer regions of rDNA were used to develop a phylogenetic species concept and pattern of speciation for *Sempervivum*. ITS1 sequences were generated from eight collections encompassing six distinct morphological species. Pairwise comparisons of sequences were used to determine if there were consistent patterns in nucleotide divergence between and within species. In aligned sequences, 23 positions were polymorphic, of which 14 were phylogenetically informative. The majority of apomorphic sites were in the ITS from *S. atlanticum*. There were no sequence differences in the three isolates of *S. tectorum*. Parsimony analysis produced five equally parsimonious trees. The consensus tree resolved *S. atlanticum*, *S. nevadense*, and *S. cantabricum* as discreet species. There was little resolution between *S. tectorum*, *S. andreanum*, and *S. pyrenaicum*. The data indicates a continuous pattern of speciation from North Africa, through Spain, the Pyrenees, to the Alps.

THE 'DALLAS BLOB'- THIRTY YEARS ON. Kevin G. Jones, Dept. of Natural Sciences, The University of Virginia's College at Wise, Wise VA 24293. In June 1973, the Dallas suburb of Garland was briefly panicked by an apparent invasion by slimy, crawling, yellow 'aliens'. This phenomenon, which became known as the 'Dallas Blob' was actually an unusually large-scale fruiting of the athelial myxomycete, *Fuligo septica*. Thirty years on, *Fuligo* has proved a valuable biological system for studying a range of myxomycete-associated questions. The abundance of spores in *Fuligo* sporocarps has allowed development of an effective DNA extraction method, applicable to a range of myxomycetes, and provided the potential for genetic fingerprinting of *Fuligo* populations, to better understand the impact of diverse reproduction systems on species-level variation. In addition, unusual patterns of 18S rDNA fragment amplification from *Fuligo* DNA support the presence of group I introns in this species, and suggest that *Fuligo* athelia are associated with a diverse and to-date, largely uncharacterized fungal flora.

A TAXONOMIC REVISION OF *SILPHIUM* (ASTERACEAE) FOR THE FLORA OF NORTH AMERICA PROJECT. Jennifer A. Clevinger, Dept. of Biology, James Madison University, Harrisonburg, VA 22807. In preparation for writing the treatment of *Silphium* for the Flora of North America project, a revision was undertaken using morphological and molecular evidence. The revision includes 12 species and 13 varieties in two sections. Section *Composita* includes four species with scapiform growth and tap roots. Section *Silphium* includes eight species with caulescent growth and fibrous roots. In Section *Silphium* there are five varieties that are new combinations in *S. asteriscus*, *S. radula* and *S. integrifolium*. Additionally *Silphium simpsonii* var. *wrightii* is reduced to synonymy under *S. radula* and *S. confertifolium* is reduced to synonymy under *S. asteriscus*.

TREE SURVEY OF LEE PARK, A SECONDARY GROWTH FOREST IN PETERSBURG, VIRGINIA. Sara Alexander & Stewart Ware, Dept. of Biol., Col. Of Wm. & Mary. In Lee Park, a secondary growth forest and wildflower refuge centered on Wilcox Lake in Petersburg, Virginia, a baseline vegetation study was conducted. Forty Bitterlich-circular plot sampling sites were taken in areas of older hardwood and maturing pine stands. For each site, basal area was determined and density within a 10 m radius circle was recorded. Relative basal area and density were found for each species, and importance value was calculated for trees having diameter >10 cm. Vegetation ordinations were constructed using both detrended correspondence analysis (DCA) and non-metric multidimensional scaling (NMS), and cluster analyses were performed. Of the 33 recorded species, 24 occurred in the overstory, largely dominated by five species of oak: white oak, scarlet oak, southern red oak, northern red oak, and chestnut oak. Loblolly pine was dominant in ten stands. Pine stands with a higher concentration of hardwood species, especially tulip poplar, sweetgum, and northern red oak, were likely further along in succession. Chestnut oak, a Piedmont species, was unusually abundant, likely due to Lee Park's location at the intersection of vegetational regions. Southern red oak and post oak showed a tendency to co-occur.

PHYLOGENETICS OF THREE RARE NORTH AMERICAN MALLOW GENERA. Tracey Slotta, Biology Department, Virginia Tech, The Malacothamnus Alliance consists of three genera, *Iliamna*, *Malacothamnus*, and *Phymosia*. *Iliamna* has 8 species, all are considered as rare, found from Virginia to California. *Malacothamnus* has 11 species, 2 are endangered and 3 are rare, endemic to California and northern Mexico. *Phymosia* has 8 species, 2 are rare, found in the Bahamas and central Mexico. the genera are group together into the alliance based on chromosome number and several morphological traits. Here, DNA sequence data were used to verify their relationships. The project aims to establish the monophyly of the alliance and determine intergeneric and interspecific relationships. Results are presented from sequence data from the nuclear ITS and GBSSI regions and the chloroplast TrnL-F region. All three regions consist of coding and non-coding segments. Of the three, GBSSI has the greatest variation. Furthermore, GBSSI is found in multiple copies, 3 in *Iliamna* and 2 in *Malacothamnus*. Preliminary morphological data are also presented. Twenty-six morphological traits were used in *Iliamna* to examine species delineations. The characters chosen exhibit significant variation that may be useful in determining species classification.

AN EXAMINATION OF EXCYSTMEN IN TWO HETEROTROPHIC DINOFLAGELLATES WITH COMPLEX LIFE CYCLES: *PFIESTERIA PISCICIDA* AND AN UNNAMED CRYPTOPERIDINIOPSOID. Todd W. Stem, Todd A. Egerton & H.G. Marshall. Department of Biological Sciences, Old Dominion University, Norfolk VA, 23529. In culture, *Pfiesteria*-Like Organisms (PLOs) behave similarly, exhibiting a life cycle that deviates from the typical dinoflagellate life cycle. This deviation includes the formation of an apparently temporary or transient cyst or resting stage. Preliminary observations made during the routine maintenance of these cultures suggest that motile zoospores enter and exit this stage in response to levels of algal prey (*Rhodomonas* sp.) available. In this study we examined how two different PLO species (*Pfiesteria piscicida* and an unnamed Cryptoperidiniopsoid) form these cysts in response to starvation, as well as how the addition of algal prey, algal prey exudate, and culture media affects the rate of excystment for both species. The results of this study suggest that the two species exhibit marked differences in the level of encystment in response to the absence of algal prey. This study also suggests that the addition of algal prey is not required in order to trigger excystment.

FLORISTIC STUDIES OF ROCKINGHAM COUNTY, VIRGINIA. Conley K. McMullen<sup>1</sup>, Melinda D. Peters<sup>1</sup> & L. Michael Hill<sup>2</sup>, <sup>1</sup>Dept. of Biology, James Madison University, <sup>2</sup>Biology Dept., Bridgewater College. In 1986, 1095 species (125 families, 490 genera) of vascular plants were reported for Rockingham County, Virginia. Since then, this county has experienced unprecedented population growth and the loss of undisturbed habitat that accompanies such growth. It is important that the flora be accurately documented at this time, to serve as a baseline for future studies as well as

to provide information to local plant taxonomists, foresters, county agents, and amateur botanists. Such a survey may also provide new plant distribution information useful to The Flora of Virginia Project. Rockingham County, located in the northwestern part of Virginia, comprises 864 square miles and is botanically rich and diverse. The crests of the Blue Ridge form the county's eastern boundary, while Shenandoah Mountain forms the western boundary. Five basic habitats are represented, including mountain crests and slopes, valley woodlands, old meadows, floodplains, and shale barrens. The study reported here, initiated in June 2002, is updating county records via new field collections and review of herbarium records. At this time, 398 new numbers have been collected. Voucher specimens are deposited in the herbarium of James Madison University (JMUH).

ESTABLISHMENT OF PERMANENT PLOTS IN THE MATOAKA WOODS, COLLEGE OF WILLIAM AND MARY, UTILIZING THE NCVS PROTOCOL. Jacob R. G. Kribel & Stewart A. Ware, Dept. of Biol., College of William and Mary, Williamsburg, VA 23185. The Matoaka Woods has been identified as one of the best examples of a maturing post-cultivation forest in the Virginia Coastal Plain (VCP). Nineteen permanent plots were established in the Matoaka Woods in the summer of 2002, utilizing the NCVS protocol. Permanent plots already established in the woods, using the combined Bitterlich-circular quadrat (CBCQ) method, were resampled and the results compared to the NCVS results. In the NCVS plots, *Fagus grandifolia*, *Quercus alba* and *Liriodendron tulipifera* had the highest importance among stems greater than 10cm, with the CBCQ plots showing the same trends. NCVS plots had *Cornus florida*, *F. grandifolia*, *Acer rubrum* and *Ilex opaca* with the highest importance among stems less than 10cm. *Quercus alba* and *F. grandifolia* dominated canopy cover, while *F. grandifolia* alone dominated intermediate cover. Detrended correspondence analysis of these results showed little separation among stands; however, plots did separate based on less than 10cm stem importance, with plots having high *F. grandifolia*, *A. rubrum*, and *I. opaca* importance grouping together and *A. rubrum* grouping separately from them.

EFFECT OF SYNSEED MATRIX, PLANTING MEDIUM, AND STORAGE ON EMERGENCE OF ENCAPSULATED *SAINTPAULIA RUPICOLA* SHOOT TIPS. Michael H. Renfro, Cierra R. Simpson, & Sarah A. McDonald, Dept. Biology, James Madison University, Harrisonburg, VA 22807. One species of African violet, *Saintpaulia rupicola*, is a critically endangered species native to Kenya. We investigated methods of propagating this plant using synthetic seeds, or synseeds. Synseeds were prepared by encapsulation of shoot primordia that had been grown in vitro from leaf explants. When comparing shoot development from synseeds composed of alginate only with shoot development from synseeds that also included nutrients in the matrix, inclusion of nutrients produced results that were not significantly different than if seeds were planted immediately. Inclusion of nutrients was beneficial if the seeds were stored for one week prior to planting. Storage for one week significantly increased shoot development from synseeds whether nutrients were included or not. Planting synseeds on a full-strength basal medium was more beneficial than planting synseeds on a reduced-strength basal medium. These results demonstrate that synseeds may be useful for propagating plants of this endangered species and thus could contribute to germplasm conservation efforts.

ANATOMY AND DEVELOPMENT OF FLOWERS IN *ACALYPHA DEAMII* AND *A. RHOMBOIDEA* (EUPHORBIACEAE); A COMPARATIVE STUDY OF STAMINATE, PISTILLATE, AND ALLOMORPHIC STRUCTURES. Patricia A. Truman & W. John Hayden, Dept. of Biol., Univ. of Richmond, Richmond, VA 23173. *Acalypha deamii*, a newly recognized element of the Virginia flora, is characterized by two-carpellate gynoecia, relatively large seeds, and routine occurrence of allomorphic pistillate flowers and fruits. Allomorphic structures are rare in the closely related *A. rhomboidea*. All reproductive structures of both species were studied via LM and SEM. Structurally, both species are similar. Staminate flowers have four crystal-encrusted valvate sepals, eight stamens, divergent vermiform anthers, helically thickened endothecium, and amoeboid tapetum. Ovules are bitegmic, crassinucellate, and anatropous. Fruits bear gland-tipped and simple,

uniserial trichomes and an internal zone of prominently sclerified cells. Inner integument features an outer layer of sclerified arcuate cells and an inner layer of tracheids. Allomorphic structures are one-carpellate; their markedly muricate surfaces lack gland-tipped trichomes, and sclereid layers of fruits are weakly developed. Similarly, testa of allomorphic seeds in *A. deamii* is weakly sclerified. Otherwise, ordinary and allomorphic reproductive structures are similar, including presence and form of evidently viable embryos.

A TAXONOMIC AND CHROMOSOMAL STUDY OF THE GENUS *TRILLIUM* (LILIACEAE) IN VIRGINIA. L. Michael Hill, Bridgewater College. The purpose of the study was to examine the genus *Trillium* in Virginia. This study involved the construction of taxonomic keys, species descriptions, distribution maps and chromosome number and structure. It is presented as a suggestion as to how *Trillium* could be treated for the Virginia Flora manual project. Chromosome number for all ten taxa was reported as  $2n=10$ , which was determined using a standard Fuelgen stain of root tip chromosomes after a colchicine pretreatment. Chromosome morphology of all ten of the taxa was also determined. For the most part, the chromosome morphology of the ten Virginia taxa were similar to published reports for the same taxa outside of Virginia, with the exception of *T. undulatum*. Also discussed was the varietal status of *Trillium pusillum*. The literature was reviewed, and chromosomal morphology of the proposed *Trillium pusillum* var. *monticulum* Bodkin and Reveal, and *T. pusillum* var. *virginianum* Fernald, were found to be the same.

ANALYSIS OF TWO GENE CANDIDATES IMPLICATED IN RESISTANCE TO MYCORRHIZAE IN *BRASSICA*. Michael Sullivan and B.B. Kreutzer, College of Integrated Science and Technology, James Madison University. Mycorrhizae are a symbiotic relationship between plant roots and fungi that are of fundamental importance to plant growth and establishment. Yet little is known about its genetics. This project examined two possible gene candidates for resistance to mycorrhizal development. PCR analysis, nucleotide sequencing and a pairwise BLAST search of two genes, defensin and RGA10, were completed for host and non-host tissues. Both defensin and RGA10 have been implicated in plant resistance to fungal infection. DNA sequences with a high homology (98%) to published defensin sequences were found in the nonhosts Brassica rapa and Brassica rapa subspecies (pekinensis) but were absent in the hosts Nicotiana tabacum and Hordeum jubatum. No RGA10 sequences were found in host or nonhost tissue. Further BLAST analysis revealed that DNA sequences with high homology to the defensin gene are found in listed nonhost plants but not in host plants. These results indicate that the defensin gene may be involved in the colonization resistance of nonhosts. A gene knock-out study is underway to test the effect that removal of the defensin gene has on the development of mycorrhizae in nonhosts.

EFFECTS OF MINING RECLAMATION ON FUNGAL BIODIVERSITY IN THE APPALACHIANS. Rebecca C. McCowan & Kevin G. Jones, Dept. of Natural Sciences, The University of Virginia's College at Wise, Wise VA 24293. This study is part of an ongoing project that investigates the effects of mine reclamation on fungal diversity at the Powell River Project in the Appalachian region. Soil samples were collected from two distinct ponds to examine the levels of fungal diversity. Serial dilutions of soil suspensions plated onto water agar suggest that the total number of culturable fungi differed approximately ten-fold between the two ponds, reflecting the divergent nature and origins of the two habitats. Fungal populations within both ponds appeared to be dominated by four morphologically distinct species. When ten randomly selected isolates were subjected to DNA extraction and PCR of the ITS regions of rDNA, amplification products fell into one of four distinct size classes. This data suggests that ITS size variation may provide a rapid means of differentiating cultured fungi, without the need for morphological discrimination. The fungal DNAs were subsequently amplified successfully using an ascomycete-specific primer pair, confirming the identity of the fungal species. Consistent reports suggest that culturing does not reflect true fungal diversity, therefore, the extraction of DNA directly from the soil is currently being studied.

MORPHOLOGY AND ANATOMY OF REPRODUCTIVE STRUCTURES OF TWO SPECIES OF *ACALYPHA* (EUPHORBIACEAE). Christopher C. Rigsby & W. John Hayden, Dept. of Biol., Univ. of Richmond, Richmond, VA 23173. As part of broad comparative studies in the genus, morphology and anatomy of staminate and pistillate flowers and fruits of *Acalypha gracilens* and *A. ostryaefolia* were studied via SEM and LM. The minute staminate flowers of both species are borne in spikes. Each staminate flower has four valvate sepals, vermiform anthers, amoeboid tapetum and tricolpate pollen. Pistillate flowers of both species are enclosed in leafy bracts; those of *A. gracilens* are solitary or occur in small axillary clusters whereas pistillate flowers of *A. ostryaefolia* are grouped in prominent terminal spikes. Pistillate flowers are naked, three-carpellate, and bear bitegmic, crassinucellate, ovules. Fruits of *A. gracilens* are covered with simple uniseriate trichomes; those of *A. ostryaefolia* are densely beset with robust multiseriate processes forming a muricate surface. Internally, pericarp of both species features three layers of sclerified cells. Inner integument bears an outer layer of sclereids and an inner layer of tracheids. Embryos are straight, oriented radicle uppermost, and surrounded by endosperm. Overall, anatomy of flowers and fruits of *A. gracilens* and *A. ostryaefolia* is consistent with reproductive structures of other local species in the genus.

CHARACTERIZATION OF THE ACIDOPHILIC DIATOM ASTERIONELLA RALFSII W. SMITH IN LAKE DRUMMOND, VIRGINIA. Lubomira Burchardt, Dept. of Hydrobiology, Adam Mickiewicz University, Poznan, Poland & Harold G. Marshall, Dept. of Biological Sciences, Old Dominion University, Norfolk, VA 23529-0266. The diatom *Asterionella ralfsii* W. Smith is a dominant species in Lake Drummond. It is seasonally associated with the diatoms *Aulacoseira granulata* and *A. herzogii*. This lake is located in southeastern Virginia, is shallow, with a maximum depth of ca. 2m, and a surface area of 7,750 ha, where the annual pH range varies from 3.2 to 6.8. The general morphology of *A. ralfsii* in Lake Drummond, including its valve length (32-55  $\mu$ m) and width dimensions, plus distinct capitate and attenuated ends, correspond to descriptions in the literature. However, there are morphological differences in the greater number of fine striae present on the valve surface (40-45 striae per 10  $\mu$ m) compared to previously described cells of *A. ralfsii* and its varieties. The morphological differences for this taxon suggest this is a new morphotype, likely of *A. ralfsii* v. *americana*. Further genetic analysis and environmental studies will determine if this is also a new ecotype.

AN EVALUATION OF PHYTOPLANKTON DYNAMICS WITHIN TIDAL FRESHWATER/OLIGOHALINE REGIONS OF THE RAPPAHANNOCK AND PAMUNKEY RIVERS, VIRGINIA. Harold G. Marshall, Old Dominion University, Norfolk, VA 23529-0266 & Lubomira Burchardt, Dept. of Hydrobiology, Adam Mickiewicz University, Poznan, Poland. Although subject to diurnal and often major seasonal changes in salinity and water flow, the tidal freshwater region supports an abundant and diverse algal flora (Marshall and Burchardt, 1998). In this study, 268 species were identified at stations in these river sites. Dominant freshwater flora were mainly diatoms, chlorophytes, and cyanobacteria, whereas, flora entering these regions with the increased salinity waters were mainly diatoms and dinoflagellates, with abundant cryptomonads within both the downstream and upstream flow. Phytoplankton abundance and composition were influenced by the seasonal timing, duration, and severity of the spring rains and development of the spring diatom bloom. The summer/fall algal presence and development was associated with the reduced amount of flow and longer residency time of water within these regions. These variations impacted the algal productivity rates and chlorophyll levels during the year, in addition to physical and chemical properties of the rivers (e.g. nutrient loads, suspended solids). (Supported by Virginia DEQ Chesapeake Bay Monitoring Program).

OBSERVATIONS AND HISTORICAL TRENDS OF A POTENTIALLY HARMFUL DINOFLAGELLATE BLOOM IN THE LAFAYETTE RIVER, NORFOLK, VIRGINIA. Todd A. Egerton<sup>1</sup>, Slawomir Cerbin<sup>2</sup> & Harold G. Marshall<sup>1</sup>, <sup>1</sup>Department of Biological Sciences, Old Dominion University, Norfolk VA 23529 and <sup>2</sup>Department of Hydrobiology, Adam Mickiewicz

University, ul. Marcelinska 4, Poznan, Poland. A largely monospecific bloom of *Cochlodinium polykrikoides* occurred in the Lafayette River and surrounding waters in Norfolk, Virginia during September 2002. Dinoflagellate concentrations of  $3\text{-}5 \times 10^6$  cells/L were observed. The bloom stained portions of the river brownish-red for over 2 weeks. The late summer and early fall development of the bloom was consistent with historical accounts. Water quality analysis indicates that the *C. polykrikoides* bloom may be related to elevated phosphorus concentrations during the summer months. The repeated occurrence of the bloom also suggests that a local cyst bed has been established within the Lafayette River.

AN ANALYSIS OF DIATOMS IN THE GUT CONTENTS OF ZOOPLANKTON IN A SMALL EUTROPHIC LAKE IN WIELKOPOLSKI NATIONAL PARK, POLAND. Todd W. Stem<sup>1</sup>, S. Cerbin<sup>1</sup>, P. Owsiany<sup>2</sup>. <sup>1</sup>Department of Biological Sciences, Old Dominion University, Norfolk VA, 23529. <sup>2</sup>Department of Hydrobiology, Adam Mickiewicz University, Poznan, Poland. In the summer of 2000 an enclosed mesocosm experiment was conducted in order to investigate the effect of varying levels of artificial plant (*Myriophyllum* sp.) substrate on zooplankton populations in a eutrophic lake. The results demonstrated that populations of copepods and cladocerans were more abundant and produced more eggs within enclosures containing artificial plants than in controls. The cause of this difference may be that within enclosures containing artificial plants, zooplankton changed feeding modes, from feeding predominantly on planktonic algae to relying more heavily on epiphytic algae (mainly diatoms). To test this hypothesis, we examined the diatom flora within the gut contents of zooplankton sampled from enclosures, and from the lake. The results of this examination show that the gut contents of zooplankton had a more diverse diatom flora than that found in water column samples for all treatments. Our results also support the conclusion that zooplankton were feeding largely on attached diatoms, as epiphytic species were dominant in gut content samples.

## Chemistry

DESIGN OF ORGANIC ACTIVATORS OF ANTITHROMBIN. Umesh R. Desai and Gunnar T. Gunnarsson, Department of Medicinal Chemistry, Virginia Commonwealth University, Richmond, VA 23298-0540. Conformational activation of antithrombin is a critical mechanism for the inhibition of factor Xa, a key enzyme of the clotting cascade. Heparin, a clinically used polyanionic polysaccharide, activates antithrombin nearly 1,000-fold. Numerous activators have been designed for the past 2 decades, however a fundamental tenet in these designs has been the assumed requirement of a saccharide backbone. We have designed small, non-saccharide, non-polymeric, organic molecules that interact with and activate antithrombin for enhanced inhibition of factor Xa. The rational design strategy was based on a computerized study of complexes of natural and mutant antithrombins with heparin-derived trisaccharide. Biochemical studies indicated that these bicyclic-unicyclic molecules bind antithrombin with equilibrium dissociation constants in the range of  $1 - 10 \mu\text{M}$  at pH 6.0,  $10^{-5}$  that compare favorably with  $2 \mu\text{M}$  observed for the reference trisaccharide. Antithrombin activation studies suggest that these rational designs accelerate the inhibition of factor Xa nearly 8 – 20-fold, much less than the 300-fold activation observed with reference trisaccharide. A series of competitive binding and competitive inhibition studies suggest our designed activators prefer to bind antithrombin in an extended heparin binding region rather than in the pentasaccharide binding site, resulting in weaker-than-expected activation. This advanced understanding will be utilized in the design of better second-generation antithrombin activators.

BACTERIAL DEGRADATION OF HALOACETIC ACID DISINFECTION BY-PRODUCTS. Laura Fauntleroy and R.L. Williams. Dept. Of Chemistry/Biochemistry, Old Dominion University, Norfolk, Virginia 23529. Water chlorination yields halogenated by-products due to the reaction of halogens with naturally occurring organics. Various water utilities have observed decreased haloacetic acids, (HAAs), in places where it was expected to be high. These places have low free chlorine and high heterotrophic plate counts. GJ-10 is a bacterium that has been shown to have

dehalogenase enzymes and, therefore, can degrade HAAs. The water system bacteria are being studied for their involvement in enzymatic degradation of DBPs. Recently, two bacteria have been isolated from a maximum residence time location, MRTL which have been shown to degrade HAAs. These two bacteria have been tentatively identified as a *Flavobacterium johnsoniae* and *Neisseria flavescens*. A colorimetric assay is being implemented to screen the bacteria for halogenase activity. Dichloroacetic acid and bromocresol purple are integrated into the medium, if the bacteria has the dehalogenase enzyme it will initiate degradation of the dichloroacetic acid causing an increase in chloride ion present. The pH will decrease due to HCl formation, causing the purple color to become yellow.

SYNTHESIS AND EVALUATION OF NOVEL CALCIUM CHANNEL BLOCKERS IN HUMAN PLATELETS. Celina Thadigiri & R.L. Williams, Department of Chemistry/Biochemistry, Old Dominion University, Norfolk, VA 23529-0126 and Yulia Dobrydneva & P. Blackmore, Department of Physiology, Eastern Virginia Medical School, Norfolk, VA 23508. It has been reported that 2-aminoethoxydiphenyl borate (2-APB) was found to inhibit thrombin-mediated influx of  $Ca^{+2}$  through calcium channels in human platelets. Based on this molecule, two sets of analogues were synthesized, characterized by IR, NMR and CHN analysis and evaluated using the Fura-2 method. One set of compounds were boron analogues of 2-APB and the second was a non-boron containing set of 2-APB analogues. These analogues were tested for biological activity and the results showed that they were not as effective calcium channel blockers as 2-APB. Two stereogenic boron analogues of 2-APB were synthesized in an effort to detect any stereo-specificity associated with the calcium channel and the activity of 2-APB. Neither compound exhibited a high degree of activity compared to 2-APB and there was no major difference in activity between the two stereoisomers suggesting that the calcium channel is not stereo-specific.

A STUDY OF THE APOPTOTIC EFFECT OF PHYTOESTROGEN-RELATED COMPOUNDS USING HUMAN BREAST CANCER CELL LINES. Randolph E. Birsch, Roy L. Williams & Mark S. Elliott, Dept. of Chemistry and Biochemistry, Old Dominion Univ., Norfolk VA 23529-0126. The research focused on measurements of apoptosis induced in two lines of human breast cancer cells (HBCC) as a means for evaluation of the toxicological properties of two possible endocrine disruptive chemicals: trans-resveratrol (TR) and the black goo complex (BG). Altered rates of proliferation were found in both TR treated and BG treated MCF-7/MDA-231 HBCC. Response to the phytoestrogen, TR, was evaluated via growth curves generated using varying quantities of that compound. Both the MCF-7 and MDA-231 HBCC were found to respond to TR with a significant change of proliferation rate both in phytoestrogen deprived medium and in TR-treated medium. Similarly, the two cell lines were treated with BG dissolved in acetone. This addition did not enhance cellular proliferation, but elicited decreased cell growth and produced an effect that was more pronounced with increased dosage of BG. Annexin V binding assays, Propidium Iodide tests, and Caspase 3 assays were employed as the means for evaluation of cause of cell death. (Supported by: Old Dominion Univ. Honors College)

THEORETICAL STUDIES (AB INITIO AND SEMI-EMPIRICAL) OF A CLASS OF ANTI-HIV COMPOUNDS – HEPT-DERIVATIVES, Ji Lim and Edmund Moses N. Ndip, Dept. of Chemistry, Hampton University, Hampton, VA 23668. Results of *ab initio* and semi empirical calculations of more than 28 1-[(2-hydroxyethoxy)-methyl]-6-(phenylthio)thymine (HEPT) analogues, non-nucleoside reverse transcriptase inhibitors specific against HIV-1 have been carried out. The starting geometry of each HEPT derivative was based on atom-atom connections. All structures were constructed and modified by either CS Chem Draw Ultra or Molecular Modeling Pro. Full geometry optimization based on either *ab initio* (HF/3-21G) or semi empirical (AM1 or PM3) of all structures was carried out by automated geometry optimization to minima. The CS ChemOffice 6.0 Ultra software on a Pentium III PC performed the calculations. In addition a number of other molecular

descriptors were calculated. Calculated ClogP's determined from this study correlate very well with experimental values from the literature. Additionally, conformational analysis was performed for each derivative based on automated routines in MMP and CONFORMER in preparation for docking studies necessary for understanding the mechanisms of inhibition.

PCLOBE: A COMPUTER PROGRAM TO TEACH QUANTUM CHEMISTRY. D. Shillady, E. Bezemer, J. Kroll, and C. Castevens, Dept. of Chemistry, Virginia Commonwealth University, Richmond, VA. PCLOBE has been developed for use in undergraduate education on PC-Windows platforms. PCLOBR is an *ab initio* quantum chemistry program designed to study organic molecules up to the size of steroids. An interface program (ROSETTA) allows PCLOBE to be run on two modeling programs, MOLUCAD (\$20) and CHEMSITE (\$97). PCLOBE offers many standard features such as Schlegel energy gradient geometry optimization, second order Moller-Plesset perturbation treatment (MP2), boys-Reeves configuration interaction with spin-projection up to hextets, and several basis sets. PCLOBE also offers single-excitation configuration interaction treatment of excited states to treat UV-VIS spectra and CD/MCD spectra. PCLOBE offers a Coulomb-Hole-correlation method for calculating energies within 0.02 Hartrees of Quantum Monte Carlo energies, exceeding the accuracy of B3LYP-Local Density methods in a 6-31G\*\* gaussian-lobe basis set.

NATURAL ENDOCRINE DISRUPTORS IN LAKE DRUMMOND. R.L. Williams, Beth Dovel & Joshua Ritchey, Department of Chemistry/Biochemistry, Old Dominion University, Norfolk, VA 23529-0126. Endocrine disruptor compounds (EDCs) are synthetic or natural organic agents that can interact with the estrogen receptor in various animals and modulate activity at the estrogen receptor. One class of natural EDCs are the isoflavonoids such as genistein, daidzein, formononetin and biochanin A. This class of compounds is known to be present in woody plant materials and may enter the environment through natural water sources. The isoflavonoids are also very potent antioxidants and have some interesting positive health effects. The water from Lake Drummond in Virginia has been reported to have an exceptional long half-life and historically has been reported to have some positive health effects. We have examined samples of this water and have found detectable levels of several of these isoflavonoid compounds. The presence of these compounds in the water may explain some of the reported health effects and their antioxidant activity may account for the longevity of these waters for drinking. The analysis of this water was done using high pressure liquid chromatography (HPLC). The conditions and results of these analyses will be reported in this paper. These isoflavonoid compounds might well be described as "good" EDCs in view of their positive health effects.

COMPARATIVE ANALYSIS OF MRNA GUANINE-N7-METHYLTRANSFERASE(GMT) IN EUKARYOTIC ORGANISMS USING INFORMATICS TOOLS. B. Kilel<sup>1</sup> & T. O. Sitz<sup>2</sup>, <sup>1</sup>School of Computational Sciences, George Mason University, Manassas, VA. 20110 & <sup>2</sup>Dept. of Biochemistry, Virginia Tech, Blacksburg, VA. 24061. Using informatics tools to compare important sequences is now feasible as structural genomics continues in importance and establishment of structure-function relationships becomes a common way of comparative analysis. The guanine-7-methyltransferase (cap-methyltransferase) was used for comparative analysis due to its importance in gene expression. The methylated cap structure is added to the nascent pre-mRNAs, which enhances several other downstream processes in gene expression including splicing of pre-mRNAs in the nucleus, initiation of protein synthesis and mRNA stability. A conversion script was written in Splus to transform mRNA GMT nucleotide and protein sequence data from the GenBank into strings and further analyzed using four informatics tools: Vista, Combinatorial Extension (CE), Crystal Vision, BlastP/BlastN. Results obtained from the different tools were easily portrayed with different color matches or mismatches which indicated dimension reduction in data. Most benefit is obtained from using all methods developed from different algorithms in order to infer function or structure similarities in the conserved regions where sequence comparison alone is not conclusive.

HYPOMETHYLATION OF MRNA IN NRK CELLS TREATED WITH CYCLOLEUCINE. T. A. Linkous and T. O. Sitz, Dept. of Biochem., Virginia Tech, Blacksburg, VA 24061. Eucaryotic mRNAs contain a 5'-cap structure, which is highly modified by methylation of both base and ribose components of its nucleotides. The most important of these methylations is that of the N-7-position of the guanine base. Without this guanine methylation the mRNA is not translated into protein, i.e. ribosomes don't bind to the message. Messenger RNA isolated from tumor cells is undermethylated at the N-7-guanine position. When Normal Rat Kidney (NRK) cells in culture were grown in low levels of methionine with the amino acid analog cycloleucine, the mRNA was hypomethylated in the cap structure. The cap methyltransferase, guanine-7-methyltransferase (GMT), can be used to determine the levels of non-methylated cap structure. When the mouse GMT was partially purified from mouse tumor cells it was found to contain at least four different methyltransferases at significant levels. Human GMT was expressed in *E. coli* on a pGEX plasmid as a fusion protein with glutathione transferase (-GT-GMT-). After a glutathione column purification the only methyltransferase present was the cap methyltransferase. This cloned enzyme proved to be a good reagent for analysis of hypomethylated cap structure and should allow the development of a rapid filter-binding assay.

THE SUBUNIT STRUCTURE OF THE CLONED HUMAN GUANINE-7-METHYLTRANSFERASE. C. M. MacCarthy and T. O. Sitz, Dept. of Biochem. Virginia Tech, Blacksburg VA 24061. The nuclear enzyme guanine-7-methyltransferase (GMT) methylates the guanine base in the 5'-cap structure found in eucaryotic mRNA. If this methylation does not occur the mRNA is not functional, i.e. is not translated into protein. Previous work from this laboratory demonstrated that the mouse GMT exist as a homodimer with a native molecular weight of about 100,000 daltons. A model of dimer formation was proposed involving 120 amino acids at the N-terminal region of the protein binding to the globular domain (356 amino acids). While the mouse enzyme (in its active form) was always found as a dimer the human GMT was found to be active as either a monomer or a dimer. When human GMT was fused with glutathione transferase and expressed in *E. coli*, the molecular weight was found to be 180,000, a dimer consisting of two subunits. Because glutathione transferase may exist as a dimer, we wanted to express the human protein as a His-Tag protein with 10 histidine amino acids at the N-terminal end (this allows the protein to be purified on a Ni-column). The His-Tag GMT had a molecular weight as determined on a gel-exclusion column of 104,000 daltons, a dimer. Recently we have expressed the cloned His-Tag GMT with 120 amino acids deleted from the N-terminus (it was found to be active) and will determine if it can form a dimer.

FABRICATION AND LASER IRRADIATION EFFECTS OF COMPOSITE MATERIALS, Christopher T. Lloyd<sup>1</sup>, Samuel D. Jensen<sup>1,2</sup>, Robert F. Cozzens<sup>1,2</sup>, <sup>1</sup>Naval Research Laboratory, 4555 Overlook Avenue, SW, Washington, DC 20375, <sup>2</sup>George Mason University, Department of Chemistry, 4400 University Drive, Fairfax, VA 22030 The laser irradiation effects of several radome composite materials are being studied in efforts to integrate defensive high-energy laser (HEL) weapon systems onboard ships of the U.S. Naval fleet. Char characteristics and compositional changes, which lead to an increase in attenuation of radar signal through the radome, are investigated. Various composites have been fabricated in order to better understand the effects of laser irradiation with common radome materials used on subsonic and supersonic antiship missiles. It was found that the degree of char not only depends upon the type of organic resin/epoxy used, but the reinforcing fabric type as well. For testing, different wavelength lasers at various power levels were utilized for comparison studies.

ENVIRONMENTALLY FRIENDLY PRODUCTION OF S-ALKYL THIOCARBAMATES, J. H. Wynne<sup>1,2\*</sup>, A. W. Snow<sup>1</sup>, and W. M. Stalick<sup>2</sup>, <sup>1</sup>Chemistry Division, Naval Research Laboratory, and <sup>2</sup>Dept. of Chemistry, GMU. *S*-Alkyl thiocarbamates have received considerable attention in recent years due to their use as herbicides. There are a variety of reported synthetic approaches to these compounds; however, most are either low yielding, require complex starting material preparation, involve the use of toxic reagents, are multi-step, or are limited in scope to the degree of substitution. This in turn limits the number of compounds that can be prepared. Other limitations of existing synthetic methods are the necessity of using elevated temperatures and pressures. We report a simple one-pot, two-step approach to these compounds. Condensation of thiols with trichloroacetyl chloride affording the corresponding thioester. Subsequent treatment with the desired amine results in the formation of the corresponding product in nearly quantitative yields. Purification of the products is easily accomplished by removal of excess reagent and solvent under reduced pressure

THE SEARCH FOR HIGH YIELDING SYNTHESSES OF PSEUDANS. Ramesh R. Pant, Sean R. Donohue, Robert V. Honeychuck & Wayne M. Stalick, Department of Chemistry, George Mason University, Fairfax VA 22030. The need for significant quantities of pseudans with straight alkyl chains of two desired lengths in the number 2 position gave rise to an effort to investigate the laboratory synthesis of these quinoline compounds by various methods. Such compounds are of interest because of their known existence and incompletely understood function in *Pseudomonas aeruginosa*. This in fact is the source of the designation pseudan. A number of different methods are available and the effort included variations on these literature methods. For example, there are a number of methods which start with the quinoline ring system intact, typically with a methyl group at position 2, ? to the nitrogen, and with a hydroxyl at the number 4 position on the same ring. After an initial examination of these methods, we settled upon a different method in which the heterocyclic ring is formed from a primary amine. We are currently examining the use of this method with the straight chain heptyl and nonyl groups, available in microscopic quantities from the bacterium, and also with the sterically hindered isopropyl group.

ADSORPTION AND THERMAL DECOMPOSITION OF BENZOTRIAZOLE ON NI(111). Jason Vincent V. de la Peña & John A. Schreifels, Department of Chemistry, George Mason University, Fairfax, Virginia 22030-4444. The adsorption and thermal decomposition of benzotriazole, a commonly used corrosion inhibitor, on Ni(111) surface was investigated using the technique of Temperature Programmed Desorption. From the TPD data, two desorption states for molecular benzotriazole were identified, one at ~240 K and another at ~275 K. From up-take curve plots, it was found that the first desorption state does not reach saturation, while the second desorption state reaches saturation at ~2 Langmuirs of exposure. Two decomposition products from the adsorbed benzotriazole were also detected at 76 and 27 amu. The 76 amu product had one desorption state at ~240 K, while the 28 amu product had two desorption states, one at ~240 K and another at ~580 K.

MODIFIED ADSORBENTS FOR 2,4-DICHLOROPHENOL REMOVAL FROM AQUEOUS SOLUTIONS. Emily Faulkenberry & Tarek Abdel-Fattah, Department of Biology, Chemistry and Environmental Science, Christopher Newport University, Newport News, VA 23606. The purpose of this study was to study the removal of 2,4 dichlorophenol (DCP) from aqueous solutions by using several modified low-cost adsorbents. The adsorbents were modified with dodecylamine (DDA) surfactant to improve their ability to remove this organic pollutant. Batch equilibrium studies were conducted at room temperature, 35 and 45 degrees Celsius. Chronic exposure to DCP results in kidney and liver damage. Naturally occurring zeolite adsorbents (clinoptilolite and chabazite) in addition to Silica gel, were compared to more conventional materials such as molecular sieves (13X and 5A), aluminum oxide, and activated carbon (Calgon Filtrabsorb 400). As temperature increased, an increased amount of DCP was adsorbed when using clinoptilolite, chabazite, silica gel, 5A, and activated carbon. However, the absorption observed with the molecular sieve 13X was basically independent from the temperature, and aluminum oxide absorbed less DCP as temperature increased.

At 45°C, activated carbon absorbed almost 100 percent of the DCP. Other adsorbents also successfully removed DCP. For example, aluminum oxide removes more than 50 percent of DCP at 24°C and the chabazite removes more than 50 percent at 45°C. In the presence of KCl solutions, as the concentration of KCl increased, the amount of DCP adsorbed decreased except activated carbon.

**ADSORPTION OF LEAD IONS BY ORGANO-SILICATE NANOCOMPOSITES.** Tarek Abdel-Fattah & Larry Isaacs, Department of Biology, Chemistry and Environmental Science, Christopher Newport University, Newport News, VA 23606. The state of Virginia has at least 35 outdoor shooting ranges not counting the military. Alternatives to effectively immobilize lead contaminants in soil and stormwater are needed by small arms range (SAR) managers to comply with environmental regulations and protect the environment. The equilibrium adsorption of aqueous  $Pb^{2+}$  by molecular sieves HMS, MCM-41, and MCM-48 were measured by graphite furnace atomic adsorption. Kinetics and isotherm models were prepared, and the effects of pH 2 to pH 12, competing ions, and 25 °C to 45 °C temperature, on performance were investigated. HMS, MCM-41 and MCM-48 reactions with  $Pb^{2+}$  were first order, with half-life reaction times of 65, 19 and 107 minutes, respectively. The batch equilibrium study  $Pb^{2+}$  data fit the Langmuir and the Freundlich isotherm models. Average percent  $Pb^{2+}$  removal at 23°C for HMS, MCM-41, and MCM-48 were 93%, 96%, and 93%, respectively. Ionic competition reduced  $Pb^{2+}$  removal by HMS, but enhanced MCM-41 and MCM-48 performance. HMS began to release  $Pb^{2+}$  ions below pH = 6 and MCM-41 and 48 began to release  $Pb^{2+}$  below pH = 4.

**ADSORPTION OF DIVALENT LEAD IONS BY ZEOLITES AND ACTIVATED CARBON.** Tarek Abdel-Fattah & Kelly B. Payne, Department of Biology, Chemistry and Environmental Science, Christopher Newport University, Newport News, VA 23606. Batch adsorption kinetic and isotherm studies were conducted to compare and evaluate different types of adsorbents for lead removal from aqueous media. The effects on lead adsorption from competing ions and temperature increases were also investigated. Adsorbent materials such as activated carbon and naturally occurring zeolites (clinoptilolite and chabazite) were selected because of their relative low cost and because the zeolites are potential point-of-use materials for mitigating waste water runoff. Molecular sieves (13X and 5A) were selected because they provide a basis for comparison with previous studies and represent well-characterized materials. The relative rate for lead adsorption was: 13X > chabazite > clinoptilolite > 5A > activated carbon. Modeling lead adsorption by different adsorbents using the Langmuir and Freundlich isotherm expressions were used to determine the adsorbents' capacity for lead removal from aqueous media. 13X, 5A, and activated carbon best fit the Langmuir isotherm expression. The zeolites best fit the Freundlich isotherm. Increasing temperature improved adsorption performance for the zeolites. Ionic effects could potentially improve performance of activated carbon but not the zeolites. Activated carbon initially showed improved adsorption with increased temperature, but further temperature increases caused a decline in lead adsorption.

**NANOCOMPOSITE MATERIAL FOR ARSENIC REMOVAL FROM AQUEOUS MEDIA.** Stephanie D. Harris & Tarek Abdel-Fattah, Department of Biology, Chemistry, and Environmental Science, Christopher Newport University, Newport News, VA 23606. The impact of natural and anthropogenic inputs of arsenic (As) into the environment, mainly in soils and waters, is considered one of the major health problems in many parts of the world. The World Health Organization set the maximum allowable limit of As in drinking water at 10 parts per billion (ppb) stating that drinking water poses the greatest threat to public health from elevated arsenic. Recently the U.S. Environmental Protection Agency proposed lowering the acceptable limit of As in drinking water from 50 ppb to 10 ppb recommending that systems be in place by 2006 to reduce levels to less than 10 ppb. In this study mesoporous organo-silicate nanocomposite materials (MCM-41, MCM-48, MCM-50, HMS, and Fe-treated-HMS) were synthesized and evaluated to determine their usefulness in water filtration, particularly for removing As from drinking water. Batch adsorption studies were conducted using 0.05 g of each material. All adsorbents removed between 15% and 35% As when

used as synthesized. However, there is a clear association between increased iron content in the adsorbent material and the amount of As removed. HMS treated with 1%, 2%, and 5% iron removed an average of 33%, 40%, and 65% As, respectively.

**SURFACTANT MODIFIED ZEOLITES FOR REMOVAL OF 2,4-DICHLOROPHENOL.** Tarek Abdel-Fattah & Brian Bishop, Department of Biology, Chemistry, and Environmental Science, Christopher Newport University Newport News, VA. Dichlorophenols (DCP) are used as starting material for herbicides, antiseptics, seed disinfectants and wood preservatives, as well as being used for water treatment chlorination and wood pulp bleaching in the paper industry. The EPA has placed 2,4-dichlorophenol on the Drinking Water Contaminant Candidate List and has set a safe concentration of  $3 \text{ mg L}^{-1}$ . The purpose for this study is to study the affinity of various low-cost native and HDTMA-modified adsorbents to remove 2,4-dichlorophenol from water and to determine which may have application in contaminated water remediation. The synthetic molecular sieves examined were 5A and 13X. The naturally occurring zeolites used were chabazite and clinoptilolite. These zeolites are composed of tetrahedral aluminum and silicate atoms connected by oxygen forming crystalline lattice structures. Surface modification of adsorbents was performed by equilibrating the material with an  $8 \text{ mmol L}^{-1}$  solution of aqueous hexadecyltrimethylammonium (HDTMA) bromide. Batch adsorption equilibrium studies were accomplished on 50 mL of aqueous 2,4-DCP ( $50 \text{ mg L}^{-1}$ ) with 0.1 grams of the adsorbent material. All adsorbent materials reflected affinity for 2,4-DCP. Both forms of activated carbon showed the greatest affinity, between 98 and 100% removed. The HDTMA-modified chabazite had the next greatest sorption, between 34 and 38%, depending on exposure time.

**ACYL INDOLES AS PRECURSORS TO CARBOLINES,** S.D. Jensen,<sup>1\*</sup> W.M. Stalick,<sup>2</sup> Sean Boson<sup>2</sup> and J. H. Wynne, <sup>1</sup>Chemistry Division, Naval Research Laboratory, and <sup>2</sup>Dept. of Chemistry, GMU. Despite the increasing interests in tryptamines and their subsequent carbazole derivatives, pyrido[3,4-*b*]indoles, very little is known about their counterparts, the corresponding [4,3-*b*] analogs. This is primarily due to the lack of availability of such compounds as well as the inability to selectively introduce functionalities into these derivatives. Our previous reported method, despite affording the desired product, proceeded in lower than expected yields, thus an alternative synthetic route was examined which would proceed in fewer steps. The improved synthesis involves the acylation of indole followed by reductive amination to afford a variety of 3-aminomethyl derivatives. Subsequent intramolecular cyclization, followed by aromatization, in a one-pot process should afford the desired fully aromatic carbolines. This new approach also allows for the introduction of a larger variety of alkyl and aryl substituents into the 1-position of the -carboline.

**GAS PHASE <sup>1</sup>H NMR.** Carly Drahus, T.N. Gallaher, and T.C. DeVore. Department of Chemistry MSC 7701, James Madison University, Harrisonburg, VA 22807. A Bruker Spectrospin 400 FT-NMR (400Mhz) equipped with a variable temperature probe was used to measure the gas phase <sup>1</sup>H NMR spectra of heptane, water, methanol, ethanol, acetone, acetic acid, and 2,4-pentanedione. Three laboratory exercises using this technique have been developed. In one the difference in the chemical shifts for the gas phase molecules compared to the chemical shifts in the neat liquid is used to estimate the shielding produced by solvation of the molecule in the neat liquid. The values observed for the shifts for CH<sub>3</sub> and CH<sub>2</sub> protons were fairly constant, but the shifts for the OH protons showed more variation. The relative intensities of the neat liquid and vapor peaks (when both were present) can also be used to determine the enthalpy of vaporization for each compound. The value obtained generally agreed to within  $\pm 5 \text{ kJ/ mol}$  of the literature value. Finally, the relative intensities of the keto and enol forms of 2,4-pentanedione can be used to determine the enthalpy change for this reaction under solvent free conditions.

THE SYNTHESIS AND KINETIC STUDY OF A MOLYBDENUM COMPLEX Brycelyn Boardman, Donna S. Amenta, and John W. Gilje, Department of Chemistry, James Madison University, Harrisonburg, VA 22807. As a part of a continuing study, this research involves the synthesis and kinetic study of a molybdenum complex that models  $[h^5-C_5H_5)(CO)_3 Mo(CH_2)_3 C_6H_5-15-crown-5]$ . The synthesis of the model molybdenum complex 8, is a two-step sequence. The preparation of a mesyl derivative 3 of 3,4-(dimethoxyphenyl)-1-propanol (1) is accomplished by the reaction of 1 with methanesulfonic anhydride (2). This was successfully carried out in a 49% yield and the product purified by column chromatography. The reaction was monitored by GC-MS, and characterized by  $^1H$  NMR and  $^{13}C$  NMR spectroscopy. The molybdenum anion 6, was then synthesized and combined with 3. This reaction yielded a deep red flaky solid, which was characterized by  $^1H$  NMR and  $^{13}C$  NMR spectroscopy. The resulting product was then used to study the migratory insertion reaction, accelerated by a 10 fold molar excess of triphenylphosphine (9). The reaction was run with and without the presence of added sodium cation and was monitored by  $^{31}P$  NMR spectroscopy. Kinetic data revealed little difference between the rate of the two migratory insertion reactions.

### Computer Science

USING UNIFIED MODELING LANGUAGE (UML) APPROACH TO MODEL DATA INTEROPERABILITY IN FEDERATED DATABASE SYSTEMS. D. N. Owunwanne, School of Computational Sciences, George Mason University, Fairfax, VA 22030. Federated database is a collection of interconnected databases. Different kinds of data models exist from diverse databases in the federation which makes it difficult to interoperate with each other. This paper discusses the use of UML approach to model a prototype of data interoperability among many heterogeneous local database sites that are participating in a Federation of databases. This prototype will model a system that allows client/server relationships between distributed objects. In this system, server objects provide services that can be invoked. To obtain interoperability, there is a format or a rule to be followed to model the system being described. This rule is termed General Metadata Bridge (GMB). The GMB representation separates the heterogeneous aspects of an existing representation into a *summary* form so that the main portion of the GMB can be expressed in a uniform representation regardless of the data model. The summary logically determines the interpretations which are to be applied to the GMB metadata expressions. As such, the system creates an environment that enables the participants in the Federation to interoperate with each other without having to know what hardware, software, operating system platform, or what communications protocol that are required.

WIRELESS INSECURITY FOR MOBILE DEVICES. J. Florendo, M. Painter, & S. Sadler, Department of Computer Science, Norfolk State University, Norfolk VA 23502. The focus of our research was to examine the three types of wireless communications, WAP, Bluetooth, and IEEE 802.11, for the security vulnerability that they each face. An IEEE 802.11 network is often connected to a wired network or the Internet unless configured as "ad-hoc", therefore it faces the aggregation of attacks from both directions. We conducted War Driving in the City of Norfolk, and gathered some statistics reflecting the current status of WLAN security deployment. We then looked at the basic security mechanisms: access control and WEP shared key authentication and come up with some quick solutions that will mitigate hacker activity on WLAN. We were able to test some of the freeware tools from the Internet that claim to seek, gather, recover, and gain access to a wireless network. Although currently there is no sure way to block out determined unauthorized users on a WLAN, we can at least ensure that intruders will find it hard to access this wireless network and go somewhere else.

DYNAMIC MULTI-MODAL MULTI-PLATFORM XML PUBLISHING. Moses C. Allotey-Pappoe & Jacquelynn R. Dolly, Department of Computer Science, Norfolk State University, Norfolk, VA 23504. }The ever-increasing demand to structure and describe data for Internet-based applications caused a rapid development and adoption of XML technologies for Internet. Information publishers are challenged with the problem of dynamically restructuring, filtering, and redefining data into formats suitable for applications on various computing platforms. This problem can be easily solved using XML, the Extensible Markup Language. Documents marked in XML, free from any format or system-dependency can then be dynamically transformed into any layout or style using the XSL, the XML Stylesheet Language. We developed an application in which documents coded in XML can be converted into three formats, HTML, WML, and XHTML + VoiceXML for three different Internet browsers (an HTML browser, a WAP browser, and a multimodal browser respectively) on demand using open-source products such as Jakarta Tomcat, Apache Cocoon and Multimodal Browser and Toolkit Beta from IBM Alphaworks. (Supported by FAA Grant Number 00-G-031 under the supervision of Dr. Mou-Liang Kung, Professor of Computer Science, Norfolk State University)

FINGERPRINTING AS A BIOMETRIC METHOD. Tiffany M. Parker, Dept. of Computer Science, Hampton University; Hampton, VA 23668. Biometrics is the science of identifying individuals by their biological traits. The oldest and most common form of biometrics is a fingerprint. Most systems for fingerprint comparison are based on minutiae matching. Minutiae are essentially terminations and bifurcations (forks) of the ridgelines. Automatic minutiae detection is a critical process, especially in low-quality fingerprint images where deficiencies add or disguise pixels that can create false or hide real minutiae. The algorithm used in my work originally identified only the main pixel that corresponds to a ridgeline, practically killing all noises and unwanted details. The problem is that good pixels are killed too. I propose that this process can be improved by saving not only the main pixel with neighbors, but also other useful pixels.

### Education

EDUCATIONAL TECHNOLOGY USE BY SECONDARY SCIENCE STUDENT TEACHERS. Karen E. Irving & Randy Bell, Center for Technology and Teacher Education, UVA. This study utilizing surveys, interviews, classroom observations, lesson plans and collected artifacts investigated the use of educational technology by fifteen student teachers that previously completed a technology rich pre-service program. These student teachers reported adequate skills and intent to use educational technology with the adequate opportunities for teaching with technology at the secondary school placement sites. Educational technology enhanced inquiry-based lessons and the relevancy of topics beyond the limitations of traditional classroom investigation. The study identified the influence of the mentor teacher attitude toward educational technology use, student teacher concerns regarding achievement level, behavioral characteristics and technology skills levels of the secondary student population and access/reliability issues as factors that facilitated and/or impeded the use of educational technology. The study explored implications of the findings for preservice teacher preparation, for student teaching placements, for preservice science teacher educators and for policy makers who support the integration of educational technology. In addition, aspects of ePCK, electronic pedagogical content knowledge, were described.

HANDS-ON SCIENCE ACTIVITIES FOR BIOLABS AT THE SCIENCE MUSEUM OF VIRGINIA. <sup>1</sup>Valerie Riley, <sup>2</sup>Elizabeth D. Alford, and <sup>2,3</sup>Eugene G. Maurakis, <sup>1</sup>Randolph-Macon College, <sup>2</sup>Science Museum of Virginia, <sup>3</sup>University of Richmond. We are creating four new laboratory areas (*BioLabs*) to allow visitors to explore science phenomena beyond what is available in the Bioscape exhibit area. As environments of discovery, the *Biolabs* will provide visitors, especially

teachers and their students, with access to authentic scientific research, involvement in problem solving experiences and manipulation of laboratory equipment. To date, we have created seven model activities, each focusing on a natural history collection from Virginia written with parent and teacher-friendly instructions. All activities are open-ended, allowing motivated learners to extend their experiences as far as they wish. Each activity in the *Biolabs* contains extensions, including “make and take” items, “See for Yourself,” resource sections, and ideas for relating the activity to the outdoors, including such adventures as field trips and guided environmental monitoring. Additionally, each *Biolab* activity will relate to a specific museum destination. Funded in part by the Richmond Academy of Medicine, and the Richmond Academy of Medicine Alliance.

**ASSESSING THE EFFECTS OF SCIENCE EDUCATION STANDARDS AND ASSESSMENTS.** Alvin M. Pettus, College of Education, James Madison University, Harrisonburg, VA. National and state-level standards and assessments for science teachers and students have received unprecedented emphasis over the last few years. The effectiveness of those standards and assessments for significantly increasing students’ ability to apply science concepts and skills is suspect. Most claims of positive effects are based on fragmented and short-term outcomes assessed by methods and instruments that lack validity for drawing meaningful, long-term, and socially relevant inferences. Data from large-scale assessments such as the National Assessment of Educational Progress (NAEP) and the Third International Mathematics and Science Study (TIMSS) provide no definitive evidence that the emphasis on standards and assessments have improved student achievement in science. As one would expect, student scores on state-level assessments increased as curricula were aligned with the assessments and teachers and students became familiar with the assessments. Data and examples provided support the argument that the science standards and assessments, as implemented, have resulted in minimal or no increase in student outcomes of long-term value. More coherent and systematic approaches to establishing and using standards and to assessing important and enduring effects of science instruction are needed.

**VOLUNTEERING: IMPROVING TEACHING & REKINDLING THE SPIRIT.** Kenneth S. Lawwill, Chantilly High School, FCPS. Veteran teachers frequently find themselves in a “professional rut”. As best practice changes and energy may diminish, numerous recent factors such as SOL’s, budget cuts and changes in student populations increase stress. Volunteering in a science-related endeavor such as a museum, zoo, or park provides renewal of interest, fun, and self-enrichment. Benefits include 1) increasing knowledge, contacts & sources, 2) engaging a more willing group of learners, and 3) interacting with actively participating scientists.

**SPACE PATROL: INDIVIDUAL AND TEAM RESEARCH IN THE COLLEGE ZOOLOGY LABORATORY.** Ronald S. Mollick, Dept. of Biol., Chem. & Environ. Sci., Christopher Newport Univ., Newport News, VA. 23606. An important goal of every Biology degree program is to give students an appreciation of the techniques and challenges associated with research. The lab exercise I call “Space Patrol” does that in my Invertebrate Zoology laboratory. It shakes the complacency of students who are used to being told exactly what to do and requires them to utilize previously learned lab skills and invent new ones. The scenario with which they are presented is based on a science fiction theme. They are given two “probes” from an unknown planet which is about to be destroyed and they are required to “...learn everything you can about the biology of the two life forms in the next three hours; the fate of an entire planet is in your hands.” This lab replaces a lab on the phylum Mollusca. The probes, respectively, contain freshwater clams and estuarine snails, representatives of the two largest taxonomic classes. They spend the period investigating any and all aspects of the biology of the two life forms and must produce a written report complete with drawings, observations and conclusions. Managing the exercise over the years was a learning process for me. I concluded that standard molluscan biology was covered adequately while at the same time allowing students to enter an enjoyable research mode. This continues to be the highest rated lab exercise in this class.

JESSIE BALL DUPONT FUND ENVIRONMENTAL SCIENCE INITIATIVE:K-12 EDUCATION EFFORTS AT THE CLAYTOR NATURE STUDY CENTER. SUMMARY REPORT, SPRING 2003. Woody McKenzie and Judy Strang, Lynchburg College. This report summarizes a three year environmental education effort funding the recent acquisition Lynchburg College's 470 acre Claytor Nature Study Center. During this time, small-group, inquiry-based activities were developed and implemented during 38 separate field trips with area K-12 students. Each field trip was accompanied with preparatory classroom workshops. During summers, a series of three teacher workshops involving approximately 55 public school teachers were administered offering curricula and materials to encourage environmental education that is also related to VA Standards of Learning. Best learning gains were noted using small groups with a high adult to student ratio (at least 1:4, often higher). This was achieved using an active volunteer base. A positive, unintended outcome was the important connection to the community through a varied base of volunteers that included professionals, retirees, students, parents, and others who also were given workshops to prepare them for field trips with students. From this initiative, a framework for experiential, small group environmental education has been established for the Claytor Nature Center.

### Environmental Science

COMPOSITION OF CRUSTACEAN ZOOPLANKTON IN LAKE DRUMMOND, VIRGINIA. S. Cerbin, Adam Michiewicz University, Department of Hydrobiology, 60-801 ul. Marcelinska 4, Poznan, Poland & H. Marshall, Old Dominion University, Department of Biological Sciences, Norfolk, Virginia, USA 23529-0266. The purpose of this study is to examine the taxonomical composition of crustacean zooplankton (Cladocera and Copepoda) species occurring in Lake Drummond. Water samples were collected during summer (July and August) and fall (November 2002). The sampling station was located at the pier on the west end of the lake. Samples were taken using a plankton tow net with mesh size of 80µm and an opening of 20 cm in diameter. The net was towed approximately 0.5m beneath the water surface. Specimens were examined under light microscope and SEM. There were four cladocerans identified in the samples: *Bosmina (Neobosmina) hagmani* STINGELIN; *B. (Sinobosmina) freyi* De Melo et HERBERT; *B. (Neobosmina) huaronensis* DELACHAUX; *diaphanosoma birgei* KORINEK and one species of copepod *Mesocyclops edzx* FORBES. *B. huaronensis*, needs further examinations of confirmation. All *Bosmina* Species found during the study are new to Lake Drummond, the most common species were *B. Hagmani* and *B. freyi*.

EVALUATION OF THE AQUATIC COMMUNITY STATUS OF TWO STREAMS IN A PRE-DEVELOPMENT AREA OF STAFFORD County, VA. Michael L. Bass, Emma B. Law, Robert H. Strickler and Laura R. Winter, Department of EnvSci & Geology, Mary Washington College. In this study using the EPA Rapiol Bioassessment Protocol for benthic macro invertebrates, the macrobenthic communities of England Run and the Unnamed Tributary were sampled seasonally for a year, and their composition was determined. The order, family, genus and species of the insects collected, as well as, their trophic type and determined. The Hilsenhoff FBI was used to compare the tolerance to pollution for the organisms found in the arthropod community. The Unnamed Tributary scored excellent while England Run scored very good to good at all sampling sites. Another metric was % EPT used to calculate the number of mayflies, stoneflies and caddisflies as a percentage of the total insect community. Again the Unnamed Tributary scored highest with 85.4 while England Run sites ranged from 37 to 77. Standard water quality parameters were measured at each station. Slight elevations for total nitrogen and phosphorus occurred in the summer months. Dissolved oxygen levels were at or above 70% saturation. Both total and fecal coliform levels were elevated at a few stations on England Run primarily due to agricultural animals have direct streams access.

EVALUATION OF A CONSTRUCTED OFF-SITE WETLAND MITIGATION AREA IN SPOTSYLVANIA, VA. Katherine L. Jennrich, Laura R. Winter & Michael L. Bass, Department of EnvSci & Geol., Mary Washington College. In an effort to mitigate the destruction of wetlands caused by building a major commercial business park, a developer constructed a 3 acre off-site wetland in the Massaponax Creek drainage basin in 1996. The area was excavated, prepared, seeded

and woody stem plants were planted within the boundary of the mitigation site. An interim report prepared in 1999 showed herbaceous wetland plant growth and some of the planted trees. In 2002 another evaluation was done primarily involving the density of the woody plants. The issued permit required a minimum woody plant density of 400 stems per acre. The area was divided into a 20sqft grid pattern and the number of woody plants per grid were counted and recorded. This showed the distribution pattern of the different woody plants over the entire site. An average of 320 woody plants per acre was shown. This density was less than the requirements of the mitigation permit. The area had experienced severe drought conditions for about three years and grazing by wildlife. Plans are being implemented to replant larger trees with organic mulch mixture. Recent rains have augmented the water levels which should increase the success of this constructed wetland.

FRESHWATER SPONGES AS PAST AND PRESENT INDICATORS OF WATER QUALITY IN LAKE DRUMMOND, VIRGINIA. Jeremy L. Hicks, Department of Biology, Old Dominion University, Norfolk, VA 23529. Upon analysis of a 19 cm sediment core, three freshwater sponge species were identified; *Anheteromeyenia ryderi*, *Anheteromeyenia argyrosperma*, and *Corvomeyenia everetti*. *A. ryderi* was dominant between 13-15 cm and again between 0-4 cm. This species is found in lightly shaded areas and tends to be present when *A. argyrosperma* and *C. everetti* are absent or low in relative abundance. *A. argyrosperma* and *C. everetti* are light-positive species that were in relatively high concentrations below 16 cm, and also between 5-12 cm. These two species are associated with each other, suggesting that they occur in similar water conditions. The source of *A. ryderi* is likely from the surrounding ditches that drain in the swamp and *A. argyrosperma* and *C. everetti* may be associated with the open water of the lake.

### Geography

THE GEOGRAPHY OF DENTAL FACILITIES IN VIRGINIA. Stephen E. Wright<sup>1</sup>, and David Cockley<sup>2</sup>, <sup>1</sup>Department of Integrated Science and Technology,<sup>2</sup> Department of Health Sciences, James Madison University, Harrisonburg, VA 22081. According to the Surgeon General adequate oral health in populations requires both available and accessible dental services including an adequate distribution of dentists. Using a proxy variable (dental facilities) for Dentists location, the purpose of this study was to explore where and why Virginia dentists geographically locate where they do. To actualize the purpose of this study the following research questions were explored and analyzed. First, what is the degree of relationship between dependent variable (DV) Dental Facilities Location and the independent variables (IVs) Population Change, Population Density, Urban Population, Rural Population, Median Family Size, Median Age of Population, Residential Stability, Education Attainment, and Median Family Income? Second, when the independent variables are entered simultaneously into the regression equation, which variables (or variable) are the best predictors of Dental Facilities Location? There were 13,182 dental facilities documented in the study's database. The regression model's Adjusted R Square was 0.731 and the best predictor of Dental Facilities was Residential Stability.

CREATING A GEOGRAPHICAL INFORMATION SYSTEM FOR FRESHWATER CRABS AND FISHES IN GREECE. Eugene G. Maurakis<sup>1,2</sup>, Walter R. T. Witschey<sup>1</sup>, and Panos S. Economidis<sup>3</sup>, <sup>1</sup>Science Museum of Virginia, 2500 W. Broad St., Richmond, VA 23220, <sup>2</sup>Biology Dept., UR, Richmond, VA 23173, and <sup>3</sup>Zoology Department, Aristotle University, Thessaloniki 54006 Greece. The objective is to create the first geographical information system (GIS) for freshwater crabs and fishes in Greece in response to the European Environmental Agency's formulation of a biodiversity initiative to inventory, identify and describe aquatic species in European Union countries. A total of 1931 collections, made with seines, dipnets, and a backpack electroshocker in 32 drainages of Greece yielded 122 species of fishes and 2,359 data points including species, latitude, longitude, drainage, prefecture, and locality; of which 731 also include stream order, elevation, gradient, stream width and depth, pH, temperature, and distance to river mouth. Preliminary GIS analyses indicate current distributions of all species, areas rich or poor in species, anomalous species distributions, areas warranting further sampling, and co-generic species whose overlapping ecological distributions call for taxonomic and phylogenetic investigation. Funded by T. F. Jeffress and K. Miller Jeffress Memorial Trust, Science Museum of Virginia, and University of Richmond.

A PROPOSED MODEL: THE EFFECTS OF LANDSCAPE LAND-COVER PATTERNS ON METAPOPOPULATION DYNAMICS. A. Scott Bellows, Cynthia M. Jones & Robert K. Rose, Department of Biological Sciences, Old Dominion University, Norfolk, VA. Early conceptual models of population dynamics did not address the influence of either the environment or nearby (sub)populations. In most traditional models of metapopulation regulation, spatial factors are only implicitly addressed. Hierarchical theory traditionally introduces environmental factors at ecosystem and landscape levels of ecology (linear and not realistic). Here we attempt a non-linear approach that will incorporate environmental influence on metapopulation regulation. Our primary objective is to generate a working single-species (grid-based) population model that will consider the collective effects of population regulation processes (birth, death, immigration, and emigration rates), landscape variation (*e.g.*, contagion, habitat quality), and regional stochasticity on metapopulation viability. This model will incorporate some functions of Boolean logic common in traditional models with additional fuzzy logic functions to incorporate variable landscape characteristics. By manipulating the vital rates of individual subpopulations (occupied patches), we could potentially simulate an infinite number of population system types that include sources and sinks, as well as open and closed populations.

NEW SEARCHES FOR LOST CITIES: THE ELECTRONIC ATLAS OF ANCIENT MAYA SITES. Walter R. T. Witschey<sup>1,2</sup> & Clifford T. Brown<sup>2</sup>, <sup>1</sup>Science Museum of Virginia, Richmond VA 23220 and <sup>2</sup>Middle American Research Institute, Tulane University, New Orleans LA 70118. The ancient Maya occupied a region comprising the modern political regions of eastern Mexico, Guatemala, Belize, and western Honduras and El Salvador. Little has been done previously to assemble a unified picture of all ancient Maya sites. We describe the problems susceptible to analysis by a unified database, accessible by GIS techniques, the implications for our data structure model, and the tools and techniques we have used to create an electronic atlas for the ancient Maya. Several challenges, including that of non-standardized data from various political subdivisions, and well as coordinate system inconsistencies and our solutions to them are outlined. We describe the use of our system to evaluate several theoretical models of settlement pattern in the Maya region. Lastly, we describe the extension of the atlas to questions of the cultural implications of regional variations in architectural styles, language, ceramics, emblem glyphs, dynastic events, and dated monuments. We conclude with a review of opportunities for further field research suggested by the GIS atlas.

### Geology

(No Abstracts Submitted)

### Materials Science

CHARACTERIZATION OF ELECTROMIGRATION IN ALUMINUM ALLOY THIN FILMS. K. E. Tinklepaugh & S. C. Matts, Department of Physics, Mary Washington College, Fredericks-burg VA 22401-5358. As microelectronic conductors shrink, they are subjected to increasingly large current densities, with more electrons dislodging more film atoms through momentum transfer. This electromigration produces material movement in the direction of electron flow and represents the fundamental failure of these conductors. To study this damage, the current density must be precisely controlled, even as sample resistance changes with time under test. To insure control, an electrical test program was written in LabVIEW. This program allows for careful testing of up to 50 samples for a variety of user-selected parameters. Surface damage was observed and quantified for test currents ranging from 80 to 180 mA using image analysis of optical micrographs. A nonlinear relationship between the amount of damage and current density will be presented. This allows for eventual calculation of metal ion drift velocity,  $v_d$ , since

$$v_d = \frac{D_o}{kT} eZ * \rho j e^{\frac{-\Delta H}{kT}}$$

where the current density,  $j$ , may have an exponent other than one. Clearly, if ways to decrease  $v_d$  can be identified, device longevity can be enhanced. This work was funded by both the Virginia Academy of Science and Mary Washington College.

### Medical Science

THE ANTINOCICEPTIVE EFFECT OF THC IN THE ARTHRITIC RAT. M. L. Cox & S.P. Welch, Dept. of Pharmacology, Virginia Commonwealth Univ., Richmond, VA 23298. We addressed the hypothesis that THC-induced release of endogenous opioids results in antinociception in arthritic (FAA) and normal (NA) rats. We characterized receptor involvement with the use of antagonists to opioid and CB1 receptors. THC-induced antinociception, attenuated by SR141716A and naloxone in both groups, has a CB1 and opioid receptor component. A kappa opioid component was suggested by the attenuation with nor-BNI in FAA rats only. Using a spinal cord perfusion technique, we measured levels of endogenous opioids in CSF. THC (i.p.) releases dynorphin A (dyn A) and leu-enkephalin (leu-enk) in CSF of NA rats, but tends to decrease release in FAA rats. Vehicle tended to increase these peptides in FAA rats. Met-enkephalin levels were higher in naïve FAA rats than NA rats, but THC did not affect release. These results further suggest a role for the kappa opioid system in THC-induced antinociception. Currently we are determining if tolerance develops to chronic administration of a combination of low doses of THC and morphine. We are also measuring dyn A levels in the CSF of these rats as well as taking spinal cord and midbrain tissue to determine receptor levels.

ECSTASY-LIKE STIMULUS EFFECTS OF COCAINE IN ANIMALS. N. Khorana, M.R. Pullagurla, A. Wesolowska, R. Young, and R.A. Glennon, Department of Medicinal Chemistry, Virginia Commonwealth university, Richmond, VA 23298. The psychoactive drugs MDMA ("Ecstasy") and cocaine both produce stimulant and amphetamine-like stimulus effects, and an increase in synaptic dopamine, serotonin and/or norepinephrine levels. By use of a drug discrimination task, the discriminative stimulus properties of ( $\pm$ )MDMA, R( )MDMA, S(+ )MDMA and cocaine were studied in rats trained to ( )MDMA (1.5 mg/kg) or cocaine (8 mg/kg). R( )MDMA ( $ED_{50} = 1.2$  mg/kg), S(+ )MDMA ( $ED_{50} = 0.8$  mg/kg) and cocaine ( $ED_{50} = 4.6$  mg/kg) generalized to ( )MDMA. However, ( )MDMA, R( )MDMA, and S(+ )MDMA displayed partial generalization in cocaine trained animals (21-79% cocaine-appropriate responding). The stimulus effects of cocaine were examined in S(+ )MDMA-trained animals, however administration of cocaine resulted in the disruption of behavior. The two widely abused drugs displayed some similarity of effect when ( )MDMA, but not cocaine, was used as the training drug. The observed asymmetric generalization might be explained by the complex, but overlapping, mechanisms of action of these agents. [Supported in part DA-01642]

CHARACTERIZATION OF A PATHOGENIC HERPES-LIKE VIRUS FROM THE CARIBBEAN SPINY LOBSTER. C. L. Hartwig & R.E. Ratzlaff, Dept. of Biol. Sci., Old Dominion University, Norfolk, VA 23529. The first naturally occurring virus to cause disease in a lobster species was recently described in the Caribbean spiny lobster, *Panulirus argus*. In order to isolate this new herpes-like virus of *Panulirus argus* (HLV-PA), hemolymph from diseased and healthy lobsters was separated using step-gradient ultracentrifugation. HLV-PA particles measuring approximately 120nm were found in hemolymph from diseased animals only. An initial volume of 7.5mls of hemolymph yielded HLV-PA containing approximately 11 ug of nucleic acid and 106 ug of protein.

There are at least 10 proteins ranging in size from 11 to 71 kD associated with the virus. Hemolymph from diseased lobsters showed protein bands similar to those of HLV-PA as well as other proteins that may reveal how invertebrates deal with viral infections. (Supported by: NSF & NOAA/National Marine Fisheries)

IMMUNOHISTOCHEMICAL ANALYSIS OF MECHANISMS OF TUMOR REGRESSION AFTER T CELL ADOPTIVE IMMUNOTHERAPY. A. Duong, L.J. Graham and H.D. Bear, Depts. of Surgery, Microbiology and Immunology, Massey Cancer Center, Virginia Commonwealth Univ., Richmond, VA, 23298. Adoptive immunotherapy (AIT) involves the transfer of anti-tumor lymphocytes to a tumor-bearing host (TBH) with the expectation of making the tumor regress. The purpose of this experiment is to study the microanatomy and mechanisms of tumors undergoing adoptive immunotherapy using immunohistological techniques. Lymphocytes from TBHs were activated and expanded *ex vivo* with bryostatin 1 and ionomycin in preparation for AIT. Three experimental groups of tumor bearing hosts were established: a control group receiving no treatment, a group receiving the chemotherapeutic drug cyclophosphamide, and a group receiving cyclophosphamide and adoptive immunotherapy. Growth and regression were recorded over several days. Tumors were excised from each of the three groups on specified days for immunohistochemical study using three different antibodies: Mac3, CD8a, and CD4. AIT coinciding with cyclophosphamide treatment resulted in complete tumor regression. Each antibody bound specifically to their respective antigens and degenerating tumors had cells that appeared to pull apart from each other.

MD-354 POTENTIATES THE ANTINOCICEPTIVE EFFECTS OF CLONIDINE. A. Wesolowska and M. Dukat, Department of Medicinal Chemistry, Virginia Commonwealth University, Richmond VA 23298. In the course of continuing studies with arylguanidines in our laboratory, meta-chlorophenylguanidine (MD-354) was synthesized and examined. MD-354 displays equipotent affinities for serotonin 5-HT<sub>3</sub> receptors ( $K_i=35$  nM) and  $\alpha_{2B}$ -adrenergic receptors ( $\alpha_{2B}$ -AR) ( $K_i=25$  nM), but somewhat lower affinity for  $\alpha_{2A}$ - and  $\alpha_{2C}$ -ARs. Because 5-HT<sub>3</sub> agonists as well as  $\alpha_{2NON-A}$ -AR agonists might be involved in antinociception, it was of interest to determine if MD-354 possesses antinociceptive properties in the tail-flick test in mice. Subcutaneous administration of MD-354 (up to 10 mg/kg) did not produce antinociception. Because clonidine, a nonselective  $\alpha_2$ AR agonist, has antinociceptive effects both in animals and humans, we investigated the effect of MD-354 in a combination with clonidine. MD-354 failed to antagonize the effect of clonidine, but a combination of an inactive dose of clonidine (0.25 mg/kg, MPE=13%) with MD-354 (MPE=8%) produced antinociception in mice (MPE=83%). The effect of MD-354 was not antagonized either by the 5-HT<sub>3</sub> antagonist zacopride nor by the  $\alpha_{2B}$ -AR-selective antagonist imiloxan. MD-354 potentiated the antinociceptive effect of clonidine, but its mechanism remains to be determined.

MD-354 POTENTIATES THE ANTINOCICEPTIVE EFFECTS OF CLONIDINE. A. Wesolowska and M. Dukat, Department of Medicinal Chemistry, Virginia Commonwealth University, Richmond VA 23298. In the course of continuing studies with arylguanidines in our laboratory, meta-chlorophenylguanidine (MD-354) was synthesized and examined. MD-354 displays equipotent affinities for serotonin 5-HT<sub>3</sub> receptors ( $K_i=35$  nM) and  $\alpha_{2B}$ -adrenergic receptors ( $\alpha_{2B}$ -AR) ( $K_i=25$  nM), but somewhat lower affinity for  $\alpha_{2A}$ - and  $\alpha_{2C}$ -ARs. Because 5-HT<sub>3</sub> agonists as well as  $\alpha_{2NON-A}$ -AR agonists might be involved in antinociception, it was of interest to determine if MD-354 possesses antinociceptive properties in the tail-flick test in mice. Subcutaneous administration of MD-354 (up to 10 mg/kg) did not produce antinociception. Because clonidine, a nonselective  $\alpha_2$ AR agonist, has antinociceptive effects both in animals and humans, we investigated the effect of MD-354 in a combination with clonidine. MD-354 failed to antagonize the effect of clonidine, but a

combination of an inactive dose of clonidine (0.25 mg/kg, MPE=13%) with MD-354 (MPE=8%) produced antinociception in mice (MPE=83%). The effect of MD-354 was not antagonized either by the 5-HT<sub>3</sub> antagonist zacopride nor by the  $\alpha_2$ -AR-selective antagonist imiloxan. MD-354 potentiated the antinociceptive effect of clonidine, but its mechanism remains to be determined.

ADAPTATION OF GPCRS IN MOUSE BRAIN FOLLOWING CHRONIC THC TREATMENT. M.P. Cassidy, L.J. Sim-Selley & D.E. Selley, Dept. of Pharmacology & Toxicology, VCU, Richmond VA 23298. The effects of  $\Delta^9$ -THC, the primary psychoactive component of marijuana, are mediated by CB<sub>1</sub> cannabinoid receptors in brain. CB<sub>1</sub> receptors produce an intracellular response by activating G-proteins of the Gi/o type. We hypothesized that receptors that are co-localized with produce a diminished signal at the level of the G-protein and adenylyl cyclase following chronic THC administration. Results in cerebellum show that CB<sub>1</sub> receptors in chronic THC treated animals produce a decreased E<sub>max</sub> and a rightward shift in the EC<sub>50</sub> value at the level of the G-protein compared with vehicle control. CB<sub>1</sub>, A1 adenosine and GABA<sub>B</sub> receptors in chronic THC treated animals produce a decreased E<sub>max</sub> of adenylyl cyclase inhibition compared to vehicle control. Furthermore, CB<sub>1</sub> and GABA<sub>B</sub> receptors in chronic THC treated animals produce a rightward shift in the EC<sub>50</sub> value. We conclude that there is heterologous desensitization of adenylyl cyclase inhibition and homologous desensitization of G-protein activation after chronic  $\Delta^9$ -THC administration in cerebellum, a region with demonstrated CB<sub>1</sub> co-localization.

NEW GENERATION OF 5HT<sub>2A</sub> ANTAGONISTS: SpAMDA & IT's ANALOGS. S. Peddi<sup>1</sup>, B.L. Roth<sup>2</sup>, R.A. Glennon<sup>1</sup> & R.B. Westkaemper<sup>1</sup>. <sup>1</sup>Department of Medicinal Chemistry, School of Pharmacy, VCU, Richmond, VA and <sup>2</sup>Departments of Psychiatry, Biochemistry and Neurosciences, CWRU, Cleveland, OH. Serotonin (5-HT) is an important modulatory neurotransmitter that generally exhibits inhibitory activity and the knowledge about its role in (patho)physiological processes, both peripherally and centrally, is steadily growing. The actions of 5-HT are mediated by a number of specific receptors which have been classified into 7-classes (5-HT<sub>1-7</sub>) including 15 different subtypes. 5-HT<sub>2</sub> receptors have a significant clinical interest because of their potential involvement in certain mental disorders. A design based approach towards novel ligands utilizing molecular modeling, ligand SAR & site-directed mutagenesis studies resulted in the synthesis of AMDA (9-aminomethyl-9,10-dihydroanthracene), a novel tricyclic antagonist for the 5-HT<sub>2A</sub> receptor (K<sub>i</sub>=20 nM). Structural modification of AMDA led to the synthesis of SpAMDA with high affinity for the 5-HT<sub>2A</sub> receptor (K<sub>i</sub>=4 nM). SpAMDA does not structurally conform to the established SAR of other high affinity ligands for the 5-HT<sub>2A</sub> receptor. Functional studies suggest SpAMDA is a potent antagonist at the 5-HT<sub>2A</sub> receptor.

EVIDENCE FOR CO-ACTIVATION OF PKC AND PKA DURING THE EXPRESSION OF A HIGH LEVEL OF MORPHINE TOLERANCE IN MICE. R.R. Javed, F.L. Smith & W.L. Dewey, Dept. of Pharmacology & Toxicology, Virginia Commonwealth Univ., Richmond VA 23298. We have previously reported that a single ICV injection of PKC or PKA inhibitor completely reversed 8-fold morphine antinociceptive tolerance. We developed a model of 45-fold tolerance that involved implantation of 75 mg morphine pellets and twice daily supplemental morphine injections. At 72-h, doses of the PKC inhibitors bisindolymaleimide I and GÖ-7874 that completely reversed 8-fold tolerance, only partly reversed the high level of tolerance to challenge doses of morphine. A partial reversal also only occurred with the PKA inhibitor KT-5720. In effort to demonstrate complete PKC-induced tolerance reversal, two site-specific inhibitors were tested. The tolerance reversal elicited by co-administering GÖ-7874 (ATP-binding site) and chelerythrine (catalytic site) was no greater than the reversal elicited by GÖ-7874 with vehicle. However, co-administering each PKC inhibitor with KT-5720 completely reversed the 45-fold morphine tolerance. Thus, both the adenylyl cyclase and phosphatidylinositol cascades appear to be concurrently active during high levels of morphine tolerance. Supported by NIDA DA-01647-26.

GRANULOCYTES INFILTRATE SYSTEMIC VASCULAR TISSUE IN WOMEN WITH PREECLAMPSIA. C.E. Leik & S.W. Walsh, Departments of Ob/Gyn & Physiology, Virginia Commonwealth University, Richmond, VA 23298. Granulocytes are activated in preeclampsia (PE), but their role in the pathogenesis of PE is unknown. We hypothesized that granulocytes infiltrate systemic vascular tissue to cause vascular dysfunction in PE. METHODS: Subcutaneous fat biopsies were obtained at C-section from 6 normal pregnant (NP) and 5 PE women. Immunohistochemical staining was performed for: CD66b, a granulocyte-specific antigen; ICAM-1, an intercellular adhesion molecule; and IL-8, a neutrophil chemokine. RESULTS: CD66b staining was significantly greater for PE than NP with regard to the number of vessels stained, endothelial cell adherence and flattening, and infiltration into the intima. The number of granulocytes/vessel was also greater for PE than NP. Staining of endothelial ICAM-1 and staining of vascular smooth muscle IL-8 was greater in PE than NP. CONCLUSION: This study is the first to show granulocyte infiltration into systemic vascular tissue in PE. These findings provide a reasonable explanation for vascular dysfunction in PE because granulocytes produce toxic substances (myeloperoxidase, superoxide, TNF, thromboxane) that could explain clinical symptoms, such as hypertension, proteinuria and edema.

NOVEL 5-HT<sub>6</sub> RECEPTOR ANTAGONISTS. M.R.Pullagurla<sup>1</sup>, M.Dukat<sup>1</sup>, B.L.Roth<sup>2</sup>, & R.A.Glennon<sup>1</sup>, <sup>1</sup>Department of Medicinal Chemistry, Virginia Commonwealth University, Richmond, VA 23298 and <sup>2</sup>Department of Biochemistry, Case Western Reserve University, Cleveland, OH. Serotonin 5-HT<sub>6</sub> receptors belong to the GPCR superfamily and are positively coupled to an adenylate cyclase second messenger system. Pharmacological data indicate that 5-HT<sub>6</sub> receptors might play a role in cognition/memory processes and seizure propagation, and that 5-HT<sub>6</sub> antagonists might be useful in the treatment of neuropsychiatric disorders, cognitive dysfunction, and as anticonvulsants. In the present investigation, structure-activity studies of the 5-HT<sub>6</sub> antagonist N<sub>1</sub>-(benzenesulfonyl)tryptamines (reported earlier from these laboratories) revealed the importance of certain structural features required for high-affinity binding at 5-HT<sub>6</sub> receptors. This study also suggested that benzenesulfonyltryptamines and 5-HT<sub>6</sub> antagonists reported by Hoffmann-La Roche (N-aryl-4-aminobenzenesulfonamides) likely bind in a different manner. In this process we have developed 5-HT<sub>6</sub> receptor antagonists of novel structure-type (e.g. 5-azatryptamine analogs such as 1-benzenesulfonyl-N,N-dimethyl-5-azatryptamine; Ki = 80 nM) that retain high affinity for 5-HT<sub>6</sub> receptors. [Supported in part by MH 60599]

BAD-MEDIATED SURVIVAL/APOPTOSIS IN ERYTHROPOIETIN-DEPENDENT ERYTHROLEUKEMIA CELLS. R.M. Abutin, H. Bao, S.M. Jacobs-Helber, H. Harada & S.T.Sawyer, Dept. of Pharmacology/Toxicology, Virginia Commonwealth University, Richmond, VA 23298. Erythropoietin (EPO) is the primary hormone required for survival of erythroid progenitors. A central regulator of survival/apoptosis is the BCL-2 family of proteins, which include the pro-apoptotic protein BAD. Survival factors such as EPO or mutations in cancer cells may activate BAD protein kinases, leading to phosphorylation and sequestration of BAD with 14-3-3 to suppress BAD activity promoting continued survival. It appears that PI3-kinase, MAP kinase and PKC pathways are involved in this phosphorylation in the HCD57(R) erythroleukemic cell line. HCD57(R) cells appear to be resistant to conditions which promote unphosphorylated BAD in the presence of EPO while HCD57(K) cells appear to be very susceptible to similar conditions. Although such conditions appear to have an effect on BAD phosphorylation to possibly mediate apoptosis in HCD57(K) cells, it is possible that other BCL-2 family proteins may be involved. Resistance to BAD-mediated apoptosis in HCD57(R) cells despite inhibition of multiple EPO-dependent signal transduction pathways presents a model through which malignant cells may escape cell death despite apoptogenic insult.

CHARACTERIZATION OF OPIOID RECEPTOR SUBTYPES IN MORPHINE TOLERANT RAT PUPS. D.C. Stoller and F.L. Smith, Dept. of Pharmacology/ Toxicology, Virginia Commonwealth Univ., Richmond, VA, 23298. Many human infants placed on extracorporeal membrane oxygenation or mechanical ventilation are continuously infused with morphine to reduce stress and provide analgesia. Morphine administration can result in the development of tolerance. We developed a model of tolerance in P14 rats that were implanted with saline- or morphine-filled osmotic minipumps to deliver 2 mg/kg/h morphine for 72 h. Following the 72 h, P17 naïve, saline-treated, and morphine-treated rats were challenged with varying doses of morphine and antinociception was assessed using the warm water tail-flick test. ED<sub>50</sub> values for naïve and saline-treated rats are 3.7 and 4.3 mg/kg, respectively. However, the antinociceptive efficacy of morphine was significantly reduced such that the dose-response curve was shifted to the right in a non-parallel fashion using morphine doses from 50 to 1000 mg/kg. Pre-treating the rats with the *kappa* antagonist nor-BNI partly antagonized this curve. We are currently investigating the contribution of *delta* opioid receptors to the dose-response curve. These results indicate that morphine may become non-selective at high doses in tolerant rats. Supported by NIDA T-32-DA-07027.

AD-CMV-R1A7: *IN VITRO* CHARACTERIZATION OF A RECOMBINANT ADENOVIRUS EXPRESSING UDP-GLUCURONOSYL TRANSFERASE 1A7. L. J. Webb, F. K. Kessler & J. K. Ritter, Dept. of Pharmacology/Toxicology, Virginia Commonwealth University, Richmond, VA 23298. UDP-glucuronosyl transferase 1A7 (UGT1A7) is a phase II enzyme usually increasing elimination of xenobiotic substances and drugs. It is expressed at low levels in the liver, but induced by several agents. It has been shown to have an *in vitro* specificity for bulky planar and non-planar phenols, such as benzo[a]pyrene (BaP) metabolites. Therefore, UGT1A7 may aid in the *in vivo* elimination of BaP, reducing its associated carcinogenic effects. To this end, a recombinant adenovirus expressing rat UGT1A7 was developed (Ad-CMV-r1A7). Western blot analysis of Gunn primary rat hepatocytes (PRH) infected with Ad-CMV-r1A7 resulted in detectable levels of UGT1A7. Furthermore, through HPLC analysis of the media, the infected PRH were able to glucuronidate acetaminophen at a higher rate than controls. By HPLC analysis, HepG2 cell lysates infected with Ad-CMV-r1A7 were found to glucuronidate BaP-7,8-*trans*-diol (BPD) yielding the K<sub>m</sub> and the V<sub>max</sub> to be 21.4 M and 200 pmol/mg/min, respectively. This research has shown that continued *in vivo* work is necessary to quantify the role of UGT1A7 in BaP metabolism. (Supported by 1R01ES07763 from NIEHS.)

SYNTHESIS AND BINDING PROPERTIES OF BUPROPION METABOLITE ISOMERS. M. L. Bondarev, T. S. Bondareva, R. Young & R. A. Glennon, Department of Medicinal Chemistry, Virginia Commonwealth University, Richmond VA 23298. Bupropion, an atypical antidepressant and smoking cessation agent, is a chiral substance existing both as (+)- and (-)-enantiomers. Bupropion does not bind at the major CNS receptors, and its mechanism of action is not well understood. Bupropion is extensively metabolized *in vivo* to form six major metabolites in humans: (+)- and (-)-*threo*hydrobupropion, (+)- and (-)-*erythro*hydrobupropion (formed in lesser amounts than the others), and (*S,S*)- and (*R,R*)-hydroxybupropion. Bupropion and its four major human metabolites [(+)- and (-)-*threo*hydrobupropion, (*S,S*)- and (*R,R*)-hydroxybupropion] were synthesized and all lacked affinity (K<sub>i</sub> >10,000 nM) for 2 2, 2 4, 3 2, 3 4, 4 4, and the major brain population ( 4 2) of nACh receptors. None of the agents showed affinity for SERT. Bupropion exhibited only low affinity for DAT. *S,S*-Hydroxybupropion showed affinity both for DAT and NET, suggesting it might be an active metabolite. Bupropion and its metabolite isomers behaved as noncompetitive antagonists in a <sup>86</sup>Rb<sup>+</sup> efflux assay in cells expressing 3 4 nACh receptors and might indirectly influence neurotransmitter reuptake. Results suggest that metabolites of bupropion could contribute to its actions. [Supported by DA-01642 and DA-05274.]

STIMULUS PROPERTIES OF BUPROPION METABOLITES IN (-)NICOTINE- AND (+)AMPHETAMINE-TRAINED RATS. T. S. Bondareva, M. L. Bondarev, R. Young & R. A. Glennon, Department of Medicinal Chemistry, Virginia Commonwealth University, Richmond, VA 23298. Bupropion is a weakly potent nicotine-like agent as well as a central stimulant used both as an antidepressant and as a smoking cessation agent. One or more bupropion metabolites might contribute to producing some of its effects. We used a drug discrimination task to examine the effect of four optical isomers [(-)*R,S*-threohydrobupropion, (+)*S,R*-threohydrobupropion, *R,R*-hydroxybupropion and *S,S*-hydroxybupropion] of the two major bupropion metabolites in rats trained (VI-15s) to discriminate the effects of 0.6 mg/kg of (-)nicotine or 1 mg/kg of (+)amphetamine ( $ED_{50} = 0.3$  mg/kg) from saline. Bupropion, but none of the metabolite isomers, substituted completely for (-)nicotine; some metabolite isomers might contribute to the stimulus actions of bupropion. *S,S*-Hydroxybupropion ( $ED_{50} = 4.4$  mg/kg), like bupropion ( $ED_{50} = 5.4$  mg/kg), produced (+)amphetamine-like stimulus effects, and might contribute to, or be responsible for, the stimulant actions of bupropion. Some effects of bupropion and hydroxybupropion could be related to indirect nACh receptor actions resulting in neurotransmitter release. [Supported in part by DA 01642 and DA 05274.]

TWO-LEVER DRUG DISCRIMINATION WITH THE ATYPICAL ANTIPSYCHOTIC CLOZAPINE IN C57BL/6 MICE. S.D. Philibin, L.E. Wise, A.J. Prus, A.L. Pehrson, & J.H. Porter, Department of Psychology, Virginia Commonwealth University, Richmond VA 23284-2018. Clozapine (CLZ) is the prototypical atypical antipsychotic drug (APD) and is superior to typical APDs for the treatment of schizophrenia. One important preclinical assay used in drug development to help identify neurotransmitter receptor targets for putative APDs is drug discrimination. CLZ drug discrimination has previously been studied using rats, pigeons, and non-human primates. The goal of the present study was to establish CLZ drug discrimination using wild-type mice. C57BL/6 mice were trained to discriminate 2.5 mg/kg CLZ (s.c.) vs. vehicle using a fixed ratio 10 reinforcement schedule for liquid reinforcement. The mice learned the discrimination in an average of 36.5 training sessions (SEM = 3.47). A dose effect curve for CLZ yielded an  $ED_{50} = 1.14$  mg/kg (95% C.I. = 0.95 – 1.37 mg/kg) with full generalization at the training dose and at 5.0 mg/kg; however, there were strong rate suppressant effects at the 5.0 dose. The typical APD haloperidol (0.05 - 0.4 mg/kg) did not substitute for CLZ. These preliminary results demonstrate that CLZ two-lever drug discrimination can be established in mice and that the results appear to be similar to that seen in other species.

THE INTERACTION OF NICOTINE AND DELTA9-TETRAHYDROCANNABINOL: A PHARMACOLOGICAL AND GENETIC APPROACH. F.M. Orgain and M. Imad Damaj, Virginia Commonwealth University Department of Pharmacology, Richmond, VA. The interaction between delta 9-tetrahydrocannabinol (THC) and nicotine has been poorly examined in spite of the high frequency of co-administration in humans. The goal of the present study was to determine the pharmacological interaction between these drugs after acute and chronic exposure. Both behavioral (agonist/antagonist) and genetic (CB1 knockout mice) approaches were utilized in this experiment. In the acute study the interaction of nicotine and THC on pain models (tail flick, hotplate), body temperature, spontaneous activity, and plus maze were examined after subcutaneous injection. Our results failed to show a significant pharmacological interaction (inhibition or enhancement) of the cannabinoid and nicotinic receptors. Similarly, studies performed after chronic exposure to both drugs did not show any significant interaction. Indeed, precipitated nicotine withdrawal in mice was not modulated by delta 9-THC nor resisted by CB1 knockout mice. This separation of the pharmacological and biochemical responses of THC and nicotine suggests co-administration does not play a significant role in the development of dependence processes.

QUATERNARY AMINOETHOXYPYRIDINE ANALOGS AS NOVEL ANTINOCICEPTIVE AGENTS. R. Simsek<sup>a</sup>, M. Dukat<sup>a</sup>, J. Chang-Fong<sup>a</sup>, M. I. Damaj<sup>b</sup>, B. R. Martin<sup>b</sup>, R. A. Glennon<sup>a</sup>, <sup>a</sup>Department of Medicinal Chemistry, Virginia Commonwealth University, <sup>b</sup> Department of Pharmacology, Virginia Commonwealth University, Richmond, VA, 23298. Opioids and NSAIDs used in the treatment of pain have some drawbacks. Nicotine is a nicotinic acetylcholinergic (nACh) receptor agonist and a potent analgesic in animals. But nicotine also has some drawbacks that include dependence liability. Dependence is a centrally mediated effect. It might be possible to decrease the central side effects of nACh agonists by reducing their blood-brain barrier penetration. The N-methyl quaternary amine analog of nicotine has twice the affinity of nicotine for  $\alpha 2$  nACh receptors (the major type of nACh receptors in brain). We prepared quaternary amine analogs of aminoethoxy pyridine nACh agonists and found that some *a*) display  $\alpha 2$  nACh receptor affinity comparable to nicotine, *b*) display up to 100-fold enhanced affinity relative to their tertiary amine counterparts, and *c*) possess significant antinociceptive actions as measured in the tail-flick assay with mice as subjects. Quaternary amine derivatives of nicotinic ligands represent a novel mechanistic approach to developing analgesic agents with reduced dependence liability and other central side effects. [Supported in part by DA-05274 and BTG International]

INDUCTION OF APOPTOSIS BY BACTERIA THAT PRODUCE PORE FORMING TOXINS. M. Dougherty & L. Ameen, Dept. of Biol., Mary Washington Col. Fredericksburg, VA 22401. Apoptosis in eucaryotic cells is induced after exposure to bacterial toxins. Both *Staphylococcus aureus* alpha toxin and streptolysin O induce apoptosis through the formation of pores in the cell membrane. ME-180 cervical cancer cells and HGF-1 human gingival fibroblasts were exposed to each of the toxins. Apoptosis was detected by DNA fragmentation. The results suggest *S. aureus* alpha toxin has the same toxicity in both cell lines. Often cancer cells have a reduced ability to undergo apoptosis. However, the data suggest the apoptotic mechanism induced through pore formation is not a mechanism affected in the transformed ME-180 cancer cells. Streptolysin O caused more apoptosis in ME-180 cells than in the HGF-1 fibroblasts. It is known that streptolysin O forms larger pores. The results further suggest that increasing the dose of alpha toxin has no additional effect.

FAAH <sup>-/-</sup> MICE EXHIBIT A CB1-MEDIATED ANALGESIC RESPONSE. C.C. Shelton, T.M. Advani, and A.H. Lichtman, Dept. of Pharmacology and Toxicology, Virginia Commonwealth University, Richmond, VA, 23298. Endocannabinoids have been implicated in the suppression of noxious stimuli including mechanical, thermal, inflammatory, chemical, and neuropathic pain for many years (Walker *et al.*, 2002). One valuable tool used to study this connection is a fatty acid amide hydrolase (FAAH) knockout mouse model. The enzyme FAAH is believed to be responsible for degrading FAAs in vivo, which participate in the modulation of the nervous system (Lichtman *et al.*, 2002). These knockout mice possess increased levels of endogenous brain lipids such as *N*-arachidonoyl ethanolamine, or anandamide, while also exhibiting a subdued pain response (Cravatt *et al.*, 2001). Anandamide has analgesic properties and is the only FAA that binds to the cannabinoid brain (CB1) receptor (Lichtman *et al.*, 2002). Here it is shown that FAAH <sup>-/-</sup> mice display a phenotypic analgesic response in numerous pain models. Moreover, the fact that administration of the CB1 receptor antagonist, SR141716A normalizes pain responsivity in the FAAH <sup>-/-</sup> mice suggests that this phenotype is CB1 receptor mediated. Collectively, these findings suggest the possibility that inhibitors targeting FAAH could potentially be developed clinically to treat pain.

THE EFFECTS OF IL-8 ON RAT SMOOTH MUSCLE CELL PROLIFERATION AND MIGRATION. A. Rollins & K. 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-8 would increase smooth muscle cell migration and proliferation. Cells were grown for 4 or 7 days

with and without IL-8 and counted to assess proliferation. Both a high (100 ng/mL) and a low (50 ng/mL) concentration of IL-8 caused an increase in cell number over cells grown in control media. A Boyden migration chamber was used to determine that both concentrations of IL-8 increased cell migration, as compared with the control. 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-8 in the atherosclerotic process.

ADRENOMEDULLIN; TREATMENT FOR CARDIAC HYPERTROPHY?. S. Breeding & K. Loesser, Dept. of Biol., Mary Washington Col. Fredericksburg, VA 22401. Right ventricular heart failure occurs when the blood is not pumped to the lungs as fast as it returns from the systemic veins. In an attempt to counteract the inadequate pumping in these conditions, the heart becomes hypertrophic, so that it can contract with more strength to produce a greater cardiac output. Over time, the heart chamber increases in size and the muscular wall becomes very thick. Adrenomedullin has been shown to be present in this type of hypertrophy, and the suggestion is that it has a protective effect, but the exact role of the hormone is unknown. In this experiment, a modification of an existing model for the study of this hormone was developed. cAMP levels were measured in the blood and heart tissue because it's accumulation has been linked to an increase in the hormone adrenomedullin. Rats were sacrificed after 30 or 60 days following ligation or sham-operation, the blood was collected by cardiac puncture and the heart and lungs removed and weighed. No significant differences were observed in cAMP levels between any of the tissue samples. However, hypertrophy was evident in both the 30 and 60 day post-ligation hearts compared to sham-operated controls. The model seems to work well and studies are underway to increase the numbers of operated animals and improve the assay for measuring cAMP in an attempt to clarify adrenomedullin's role in cardiac hypertrophy.

VITAMIN B AND PLASMA HOMOCYSTEINE:ATHEROSCLEROTIC EFFECTS. E. Davis & K. Loesser, Dept. of Biol., Mary Washington Col. Fredericksburg, VA 22401. The effect of decreasing plasma homocysteine concentration on the development of occlusive atherosclerotic plaques was studied in 14 hyperlipidemic mice (strain C57BL/6J, Jackson Labs, Maine). Two groups of five mice were fed high fat diets with one group receiving supplements of vitamins B<sub>6</sub>, B<sub>12</sub>, and folate. The last group of four mice was fed a non-supplemented regular diet. It was thought that the B-vitamin supplementation would decrease the plasma homocysteine concentration thus reducing vascular occlusion due to atherosclerosis. After sixteen weeks of treatment the total serum cholesterol and triglyceride levels were measured as well as the amount of occlusion in the abdominal aorta and the vessels of the heart. Plasma homocysteine levels were unable to be measured due to lack of sufficient serum. It was found that the high fat diet group had the largest amount of vascular occlusion as well as the highest cholesterol and triglyceride levels, although the measured differences were not significant. The results of this study suggest that B-vitamins do play a role in decreasing vascular occlusion. It was not determined whether the role B-vitamins play in decreasing occlusion is due to a lowered homocysteine concentration. The results of this study indicate that B-vitamin supplementation may be a useful tool in combating cardiovascular disease.

NOVEL 5-HT<sub>5A</sub> RECEPTOR LIGANDS. N. Khorana<sup>1</sup>, M. Dukat<sup>1</sup>, M. Teitler<sup>2</sup> & R.A. Glennon<sup>1</sup>,  
<sup>1</sup>Department of Medicinal Chemistry, Virginia Commonwealth university, Richmond, VA 23298 and  
<sup>2</sup>Department of Pharmacology, Albany Medical College, Albany, NY 12208. The 5-HT<sub>5</sub> receptor subfamily was discovered in 1992 and the pharmacological and biochemical mechanisms of this receptor are still unclear due to a lack of selective ligands. 5-HT<sub>5</sub> receptors are believed to play a role in migraine, psychiatric disorders, and learning ability. There are two subtypes of 5-HT<sub>5</sub> receptors but only 5-HT<sub>5A</sub> receptors exist in humans. g-Carboline derivatives were identified as novel ligands for 5-HT<sub>5A</sub> (and 5-HT<sub>2</sub>) receptors, their structure-affinity relationships were investigated, CoMFA studies were conducted, and a working pharmacophore model for the binding of carbolines at 5-HT<sub>5A</sub> receptors was formulated. There was a significant correlation (r = 0.9) for the binding of -carboline derivatives at *m*5-HT<sub>5A</sub> and *h*5-HT<sub>5A</sub> receptors. However, there was a poor correlation between 5-

HT<sub>5A</sub> and 5-HT<sub>2</sub> receptor affinity; hence, it should be possible to improve their 5-HT<sub>5A</sub> selectivity. In this study we have identified several  $\alpha$ -carboline analogs as novel 5-HT<sub>5A</sub> receptor ligands.

CANNABINOID AND OPIOID RECEPTOR FUNCTION IN ARTHRITIC AND NON-ARTHRITIC RAT BRAIN. D.L. Cichewicz, S.P. Welch and L.J. Sim-Selley, Dept. of Pharmacology/Toxicology, Virginia Commonwealth University, Richmond, VA 23298. Freund's adjuvant-treated rats develop polyarthritis, yielding an animal model of chronic pain and inflammation. Arthritic rats show an alteration in the effects of opioid receptor agonists and antagonists, as well as an increase in spinal endogenous opioids released by the administration of the cannabinoid delta 9-THC. Thus, it is possible that functional alterations in the opioid and cannabinoid systems may result from the induction of chronic pain. We used the [<sup>35</sup>S]GTP S autoradiographic assay to assess basal opioid and cannabinoid receptor stimulation in untreated arthritic and non-arthritic rat brain slices. The opioid receptor agonist DAMGO, the CB1 receptor agonist WIN 55,212-2 and the ORL receptor agonist orphanin FQ all acted as full agonists in the assay, producing significant stimulation of G-protein activation as compared to unstimulated controls. However, there were no differences observed in opioid- or cannabinoid-stimulated G-protein activation between arthritic and non-arthritic brain areas studied, including the striatum, thalamus and periaqueductal gray. Thus, it seems that at the G-protein level, there are no chronic deficits in the ability of these receptors to be stimulated after induction of arthritis.

### Natural History & Biodiversity

ESSENTIAL OILS IN SUBTERRANEAN TERMITE BAITS. Laura K. Baron & Deborah A. Waller, Dept. of Biol., Old Dominion Univ., Norfolk, VA 23529. Little is known of the feeding habits of subterranean termites, which are important pests in urban habitats. Effective termite control using baiting technology relies on the identification of chemicals that attract or repel termite foragers. In the present study, we examined the responses of the subterranean termites *Reticulitermes flavipes* (three colonies) and *R. virginicus* (two colonies) to five essential oils. For each of the five colonies, there were two experimental units per oil. Each unit consisted of a central 59 ml cup attached by straws to four similar cups (two control and two treatment). Each cup was filled with 30 ml sterilized sand saturated with 10 ml deionized water. Treatment cups included a 6 ml diam circle of tissue paper with a drop of essential oil, and control cups had untreated tissue circles. Nine termite workers and one soldier were added to each central cup. For four of the oils, several termites entered treatment cups and died there. For one of the oils, most of the termites entered the treatment cup and remained there alive but not feeding. All of these oils show promise for use in attractive but lethal baits.

BIODIVERSITY OF MITE INHABITANTS OF THE FLUID-FILLED PITCHERS OF *NEPENTHES* IN BRUNEI, NORTHERN BORNEO. N. J. Fashing, Dept. of Biol., Col. of William & Mary, Williamsburg, VA 23187. The pitchers of *Nepenthes* not only capture and digest arthropods, but also harbor arthropod communities representing several trophic levels. Because they are easily manipulated, *Nepenthes* pitchers provide excellent model microcosms that are currently used to test community theory. Although an understanding of the roles all resident species play is essential for a total understanding of food webs and community dynamics, mite inhabitants are usually ignored even though they usually occur in large numbers. This is undoubtedly due to small size and a lack of knowledge of their biology and systematics. Until this study, only four species had been described. A cursory examination of six *Nepenthes* species in Brunei revealed not only mite species belonging to two existing genera in the family Histiostomatidae, but also species from three additional and as yet undescribed genera. In addition, a sixth genus, *Naiadacarus* (family Acaridae), was observed. The exact number of species is not yet determined, but 12 is a conservative estimate. While some mite species are generalists inhabiting several *Nepenthes* species, others are confined to a single species. I examined only six species of *Nepenthes*, but to date over 80 have been described. Numerous undescribed species of *Nepenthes*-inhabiting mites undoubtedly exist.

ANT SPECIES COLLECTED IN MALAISE TRAPS IN BURNED AND UNBURNED AREAS IN A LONGLEAF HABITAT. Deborah A. Waller, Dept. of Biol., Old Dominion Univ., Norfolk, VA 23529. Malaise traps are tent-like structures that are typically used to capture flying insects. However, ground-dwelling arthropods sometimes crawl into the traps as well. In the present study, I examined the worker ants that were collected in four malaise traps at the Blackwater Ecological Preserve (BEP) in southeastern Virginia. Areas of BEP are subjected to prescribed burns to maintain the longleaf pine habitat, which is fire-dependent. Two traps were established in sites burned the previous year in 2001 (B1 & B2), with two additional traps in never-burned, control sites (C1 & C2). Ants were identified from traps collected in April and May 2002. Fifteen ant species were collected, with similar numbers of species from burned and control sites (B1= 7, B2=7, C1=10, C2=8). Several arboreal species, including *Leptothorax shaumi* and three *Camponotus* species that are rarely collected from the ground were recovered from the traps. Therefore, malaise traps may be an effective method of sampling the arboreal ant fauna.

AN EVALUATION OF ADULT FRESHWATER MUSSELS HELD IN CAPTIVITY AT THE WHITE SULPHUR SPRINGS NATIONAL FISH HATCHERY. Julie L. Boyles & Richard J. Neves. Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061. Due to the increasing need to provide refugia to freshwater mussels impacted by anthropogenic activities and exotic species, facilities and protocols need to be identified and developed for safely holding mussels in captivity. For nearly eight years White Sulphur Springs National Fish Hatchery, White Sulphur Springs, WV has served as a refuge and home to freshwater mussels. The location of the hatchery in the Ohio River Basin and its proximity to the Upper Tennessee River Basin, both home to numerous declining and imperiled mussel species, provides potential for it to become an important refuge and propagation facility for freshwater mussels. This study is being conducted to determine the feasibility of using the hatchery as a refugium for adult freshwater mussels compromised by zebra mussels, and to sustain broodstock of threatened and endangered species for propagation. Three species of freshwater mussels, *Actinonaias ligamentina* (Mucket), *Tritogonia verrucosa* (Pistol grip), and *Cyclonaias tuberculata* (Purple wartyback), from the New River drainage were relocated in June of 2001 to a re-circulating pond system at the hatchery. Commercial Nitrate and Phosphate fertilizers were added to the pond system to increase algal content. To assess food availability, water samples were collected periodically and analyzed for algal density and composition. Mantle tissue was collected from a sample of individuals of each mussel species approximately every two months. Glycogen content in the collected mantle tissue was compared over a period of one year to glycogen content in mantle tissue of mussels from the wild populations. Preliminary data show a significant difference at 1 sample event for Mucket and 1 sample event for Purple Wartyback between the control mussels in the river and the relocated mussels at the hatchery. The continuation of this study will include comparisons of lipid content, protein content, and gametogenesis of mussels from the hatchery to those from the wild populations.

OCCURRENCE OF FRESHWATER CRABS SPECIES (*POTAMON*, BRACHYURA) RELATIVE TO LOTIC STREAM FACTORS IN GREECE. Eugene G. Maurakis<sup>1,2</sup>, David V. Grimes<sup>2</sup>, Lauren McGovern<sup>2</sup>, & Peter J. Hogarth<sup>3</sup>, <sup>1</sup>Science Museum of Virginia, 2500 W. Broad St., Richmond, VA 23220 USA, <sup>2</sup>Biology Dept. UR, Richmond, VA 23173, <sup>3</sup>University of York. Objectives are to present current distributions of species of *Potamon* in Greece, and evaluate effects of stream order and distance from mouth of river on distributions of the species in river drainages in the country. We present new records of *Potamon fluviatile* in the Kalamas, Aheron, and Arachthos river drainages in southwestern mainland Greece; and in the Pinios, Piros-Tethreas, Pamisos, and Evrotas drainages in Peloponnesos, Greece. Average crab occurrence (average = 0.26) at lower river km (range = 0–150 km) was significantly greater than that (0) at higher river km (range = 151–450 km). Likewise, average crab occurrence (average = 0.26) in lower stream orders (1<sup>st</sup> and 2<sup>nd</sup>) was significantly greater than that (0) at higher stream orders (4<sup>th</sup> and 5<sup>th</sup>). Water temperature may be involved in limiting crab distributions in rivers as lower temperatures were correlated with greater distances from river mouth where fewer crabs were encountered. Funded by T. F. Jeffress and K. Miller Jeffress Memorial Trust, Science Museum of Virginia, and University of Richmond.

PREDICTING FISH SPECIES DIVERSITY IN LOTIC FRESHWATERS OF GREECE. Eugene G. Maurakis, Science Museum of Virginia, 2500 W. Broad St., Richmond, VA 23220 and David V. Grimes, School of Continuing Studies, UR, Richmond, VA 23173. Objectives were to test the hypothesis that stream order and stream width account for species diversity in drainages of Greece, and create a mathematical model to predict fish diversity. Thirty-eight species of fishes representing 12 families were collected in five stream orders (1, 2, 3, 4, and 5) from 16 river drainages in Greece from 2000-2002. Results of stepwise regression indicated that stream order, elevation, stream depth, and river km were significant factors associated with ichthyofaunal diversity. These variables and the regression intercept were used to create a mathematical model to predict species diversity per stream order in freshwater lotic environments in Greece. We conclude that geo-specific factors (i.e., isolated and small river drainages with limited water budgets, geological history, dry climate) need to be included in the EEA monitoring design for lotic waters in the harsh environments of southern Mediterranean countries as these features differ significantly from those of central, eastern, and northern European countries with larger watersheds. Funded by T. F. Jeffress and K. Miller Jeffress Memorial Trust, Science Museum of Virginia and UR.

SEXUAL AND SEASONAL VARIATIONS OF MERCURY IN SMALLMOUTH BASS (*MICROPTERUS DOLOMIEU*) FROM THE SOUTH FORK SHENANDOAH RIVER, VIRGINIA. Gregory W. Murphy, Tammy J. Newcomb & Donald J. Orth, Department of Fisheries & Wildlife Sciences, Virginia Polytechnic Institute & State University, Blacksburg, VA 24061. Smallmouth bass were collected from the South Fork Shenandoah River, Virginia during three sampling periods in 2002: spring (April 11); summer (July 17); and fall (October 1). Total mercury concentrations ranged from 0.38 to 1.38 ppm. Mean mercury concentrations adjusted for total length were significantly different between males and females ( $P = 0.0158$ ) and nearly significant between seasons ( $P = 0.0516$ ). Female smallmouth bass consistently had higher mean mercury concentrations adjusted for total length than males. In addition, mean mercury concentrations adjusted for total length were highest in the spring for both male and female smallmouth bass. These results suggest that natural resource managers that oversee mercury monitoring programs may want to assess mercury concentrations in smallmouth bass during standardized sampling periods and record sex of fish so that data can be more accurately compared among water bodies and tracked over time.

PROPAGATION AND CULTURE OF ENDANGERED JUVENILE FRESHWATER MUSSELS IN THE BIG SOUTH FORK CUMBERLAND RIVER. Rachel Mair<sup>1</sup>, Jess Jones<sup>1</sup>, Richard J. Neves<sup>1</sup>, Steve Ahlstedt<sup>2</sup>, & Steve Bakaletz<sup>3</sup>. <sup>1</sup>Freshwater Mollusk Conservation Center, Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061. <sup>2</sup>U.S. Geological Survey, Knoxville, TN 37921. <sup>3</sup>National Park Service, Oneida, TN 37841. Historically, the Big South Fork Cumberland River supported at least 50 mussel species; 26 species remain, to include five federally listed species. A cooperative effort between National Fish and Wildlife Foundation, Tennessee Wildlife Resource Agency, United States Fish and Wildlife Service, United States Geological Survey, National Park Service, and Virginia Tech was initiated to propagate endangered mussels in the Big South Fork Cumberland River National Recreation Area. The goal of this 2-year project is to assess the feasibility of restoring and augmenting existing populations of endangered mussel species in this national park. Because of high richness and endemism of mussel species, this watershed is of national significance to conservation of mussel resources in the United States. In 2002, juvenile mussels of 4 federally endangered species were produced and cultured at Virginia Tech for release in the river: tan riffleshell, *Epioblasma florentina walkeri* (4,654), Cumberland bean, *Villosa trabalis* (1,174), Cumberland combshell, *Epioblasma brevidens* (36,466), and little-wing pearl mussel, *Pegias fabula* (569). Juveniles were typically 2-3 wk old at the time of their release, although some were as old as 6 mo. The results of recent surveys in the river have documented viable populations of these endangered mussel species, which can now serve as broodstock to restore other rivers in the Cumberland River drainage system.

### Psychology

FRAMES OF MIND: GENDER AND RESPONSE TO SEXUAL AND EMOTIONAL INFIDELITY. Lauren S. Egbert & Heather M. Niesman. Dept. of Psych., Washington and Lee Univ., Lexington, VA, 24450. Are there gender differences in response to the perceived sexual and emotional infidelity of a romantic partner, and are these responses affected by priming subjects with video clips? Subjects were presented with one of three short video clips (containing an emotional/sexual/neutral scene), and then they completed a survey which asked them to indicate if the sexual infidelity of a partner or the emotional infidelity of a partner would distress them more. The subjects read detailed scenarios involving the infidelity of a romantic partner, and were then asked to indicate their level of various emotions. Female subjects indicated greater distress when faced with the emotional infidelity of a partner. Male subjects indicated approximately equal levels of distress for both emotional and sexual infidelity, however males were more upset than females by the sexual infidelity of a partner. Priming with video clips did have an effect on participant responses regardless of gender. Subjects primed with sexual video clips tended to be more distressed by emotional infidelity than the other two priming groups. Subjects primed with emotional video clips were least upset by emotional infidelity and the neutral priming group fell somewhat in the middle.

ATTRIBUTIONS OF MEMORY FAILURES. Julia E. Fitzer, Ryan M. Clements, & Elise E. Judd, Dept. of Psychology, Washington and Lee University, Lexington VA 24450. Past research has suggested that memory failures in the elderly may be mediated by social and cognitive factors as much as biological factors. The present experiment extends a vignette-rating paradigm of examining stereotypes. College-age and elderly participants read vignettes about forgetful targets whose age varied within-subjects and then rated the targets' control over their memory performance. Elderly targets received lower control ratings. College students, compared to elderly participants, viewed memory loss over time as less controllable, but tended to view targets as more independent in memory performance. Participants viewed the target of their own age group as less likely than the other target to view the memory failure as an indicator of Alzheimer's disease pathology. Participants also viewed the target of their own age group as having more independence than the other target. Ratings of the targets' present memory ability were not affected by stereotypes.

INCREASING INTRINSIC MOTIVATION FOR CLASSROOM LEARNING BY ELEMENTARY AND COLLEGE STUDENTS. M. C. Mazza, E. G. Small, & H. M. Niesman, Department of Psychology, Washington and Lee University, Lexington VA 24450. This study sought to simulate the classroom experience and investigate motivation towards learning in college students, 4th graders, and 2<sup>nd</sup> graders as influenced by verbal feedback from a teacher figure, the presence of peers, and the subject's own beliefs. The experiment involved four trials with easy or difficult symbol marking problems in the presence or absence of praise, encouragement, or general feedback. A free time period absent the experimenter allowed for further attempts on the tasks or the reading of magazines. Modified versions of Harter's scale of intrinsic versus extrinsic orientation in the classroom and Kelly's survey of preference for praise or encouragement were administered. A separate survey evaluated affective responses to the experiment, goals in learning, and failure attributions. College students responded best in the difficult task after receiving praise in an earlier easy task as opposed to receiving encouragement or general feedback. For second graders, encouragement in an easy trial produced the best performance in the easy trial and the best in returning to an easy trial after a hard trial. Results of the surveys were discussed in terms of grade level and implications for further research.

THE RELATIONSHIP BETWEEN ILLICIT DRUGS AND NOVELTY-SEEKING, NEUROTICISM AND EXTRAVERSION: A TWIN MODELING APPROACH. Arpana Agrawal, Kristen C. Jacobson, Carol A. Prescott & Kenneth S. Kendler, Virginia Institute of Psychiatric and Behavioral Genetics, VCU, Richmond, VA 23298-0003. Several studies have implicated the role of

personality measures such as novelty-seeking, extraversion and neuroticism in drug use and abuse/dependence. These dimensions of personality are proposed as risk factors for an individual's drug habit. The goal of this analysis was to decompose sources of variance using a cholesky decomposition and estimate the amount of genetic and environmental overlap between factors influencing personality and illicit drug use and abuse/dependence. Using data from 1921 female twins from the Mid-Atlantic Twin Registry, we used the structural equation modeling package Mx to perform a cholesky decomposition for each personality measure for drug use and abuse/dependence. The results suggested that novelty-seeking was phenotypically most closely related to illicit drug use. In all cases, the phenotypic relationship was moderate. Across all the personality measures, genetic factors accounted for the major proportion of the total covariance. The correlation was significantly diminished for abuse/dependence.

AN INTERVENTION TO INCREASE SAFETY BELT USAGE AMONG COLLEGE STUDENTS. C.S. Shier, K.L. Hebert & B.E. Porter, Department of Psychology, Old Dominion University, Norfolk, VA 23529. The purpose of this study was to find an intervention to increase safety belt use and to find out who the focus group is for future research. The researcher desired to observe if demographics had an effect on the difference of safety belt usage. The researcher was also interested in finding if people were more willing to wear their safety belts if they made a commitment for a certain period of time to do so. The data was collected from three different locations at different times of the day. Research assistants observed a sample of drivers at a southeastern university, and the research assistants found significant differences in gender and vehicle type for the use of safety belts, however there was no significant difference in safety belt usage before and after the intervention of recruiting participants.

THE EFFECTS OF WORKLOAD AND LEADERSHIP STYLE ON TASK PERFORMANCE AND CO-PILOT SATISFACTION. Corey K. Fallon & James P. Bliss, Dept. of Psych., Old Dominion Univ., Norfolk VA 23505. Previous research has indicated that the majority of human errors made in the cockpit are the result of a break down in the transfer of information. This study examines the problem by manipulating communication through leadership style and studying its effects on performance and satisfaction under conditions of high and low workload. The participants in this study were ODU psychology students and they performed the study in pairs. The roles of pilot and copilot were randomly assigned to participants in each dyad. Dyad's team performance was then measured on a secondary alarm response task. Next, surveys were administered to collect data on copilot's worker satisfaction during the experimental session. Statistical analysis of the data revealed that dyads in the low workload condition reacted to the alarms significantly faster ( $p < .025$ ). These results may be of practical importance to cockpit designers by showing that slow reaction time due to an unreliable system may be exacerbated by levels of high mental workload. The results also indicate that copilots were significantly more satisfied when working in the participative condition ( $p < .01$ ). This finding is important because copilot dissatisfaction could have negative long-term effects on flight crew performance.

THE RELATIONSHIP BETWEEN CULTURAL DIVERSITY AND SUCCESS OF GLOBAL VIRTUAL TEAMS. Katherine A. Selgrade & Donald D. Davis, Dept. of Psyc., Old Dominion Univ., Norfolk, VA 23508. The working environments of today are growing increasingly diverse, they are experiencing more use of work teams, and advanced technology has provided opportunities for these teams to be Global Virtual Teams (GVTs). The purpose of this secondary data analysis was to determine what type of correlation exists between cultural diversity of GVTs and overall success of the teams, and how cultural diversity training related to this correlation. Cultural diversity was examined using measures of the teams' cultural complexity. Managers of forty-three GVTs from four multinational firms were interviewed with closed and open-ended questions. Results of four hierarchical multiple regressions indicated that cultural diversity training was significantly positively related to team effectiveness, satisfaction, and overall success, but not team commitment. Also, after

controlling for cultural diversity training, relative cultural complexity measures that were calculated using scores from individualism and power distance scales were significantly related to team commitment and overall success, only. Discussion focused on possible directions of future research and limitations of the study.

BELONGING AND CONTRIBUTING: VALIDATION OF AN INCLUSION MEASURE. L.M. Germano, D.A. Major, T.D. Fletcher, S.M. Clarke, & R.A. Cardenas, Department of Psychology, Old Dominion University, Norfolk, VA 23529-0267. Promoting diversity in the workplace is no longer sufficient. Organizations need to harness the power of diversity by creating inclusive climates at work. Inclusive organizational climates involve all members regardless of gender, religion, race, color, sexual orientation, national origin, age, or physical ability, in the activities and processes of the organization. This study examined the psychometric properties of an inclusion construct. Two hundred forty-four college students completed a web-based survey that asked questions about climate for opportunity and inclusion in the workplace, as well as the antecedents and consequences of that climate. The measure's content, face, convergent, divergent, criterion-related, and construct validity were assessed. Support for a two-dimensional model of inclusion was obtained by deleting two items.

RELATIONSHIPS AMONG GENDER, LOCUS OF CONTROL, PREFERRED NAVIGATION STRATEGY, AND NAVIGATION PERFORMANCE. E. Carpenter, C. Baldwin, & H. Furukawa, Department of Psychology, Old Dominion University, Norfolk VA 23529. In Experiment 1, factor analyses of two commonly used wayfinding/sense of direction scales were conducted using data from 239 participants. In Experiment 2, sixteen participants completed scales to assess their preferred navigation (wayfinding) strategies and locus of control. This was followed by a driving simulator task in which participants were cued to search for landmarks and create mental maps of the routes that they drove. Questions related to the landmarks and their cardinal direction from the start and endpoints of the routes were the navigation performance measure. Results indicated significant correlations between males and a survey navigation strategy ( $r = .46$ ,  $p < .01$ ), survey navigation strategy preference and performance ( $r = .39$ ,  $p < .05$ ), and no significant correlation between navigation strategy and locus of control.

ASSESSING THE RELATION OF MOVIE WATCHING TO MEMORY FOR CHARACTER SEX IN POSITIVE AND NEGATIVE STORIES. Lindsay M. Boutwell, Danielle N. Taylor, Janet M. Philips, Kellea J. Hester, Cheryl A. Taylor, & Jeffrey A. Gibbons, Dept of Psych, Christopher Newport Univ, Newport News, VA. This experiment examined the effect of movie media on the memory for character sex in short stories. A total of 125 students from Christopher Newport University were asked to read 4 scenarios, which were created by crossing male and female characters with positive and negative actions. Each scenario also had a supporting character having opposite sex of the main character. After reading the scenarios and completing an interpolated task, the participants' memories were evaluated and analyzed for character sex and story affect. The participants were also required to complete a questionnaire listing their 4 favorite television shows and the last 4 movies they watched, either box office or rental. The questionnaire was designed to determine if movies influenced the participants' memories of the characters in the scenarios. The results showed a trend, such that participants remembered character sex better for male characters in positive scenarios than female characters from positive scenarios, and this difference was larger for participants who watched recent movies with male lead characters compared to participants who watched recent movies with female lead characters.

THE RELATIONSHIP BETWEEN HIV VIRAL LOAD AND ANXIETY AND DEPRESSION. Schultz, S.A.<sup>1</sup>, Duncan, P.M.<sup>1</sup>, & LaRocco, A.<sup>2</sup> (2003). <sup>1</sup>Old Dominion University, Norfolk, VA and <sup>2</sup>Eastern Virginia Medical School, Norfolk, VA. Prior research has suggested that HIV-infected persons with high viral loads are more likely to experience anxious and depressive symptomology. The present study investigated whether a positive relationship exists between HIV viral load and anxiety and depression. Participants included 90 HIV-infected persons and 22 HIV-negative controls. Participants were recruited by Dr. Anthony LaRocco at patient clinics at EVMS, Norfolk, Virginia. After giving informed consent, participants completed the Hospital Anxiety and Depression Scale (HADS) and viral load counts were obtained from medical records. A Pearson's r correlation indicated that anxiety and depression and viral load have a significant positive relationship. The researcher also investigated the effects of gender and HIV status (HIV-negative or HIV-positive) on a measure of anxiety and depression. A 2x2 between subjects factorial ANOVA indicated that HIV-infected individuals experience significantly more anxiety and depression than HIV-negative controls. Implications for improved treatment of HIV patients' mental health problems are discussed.

EFFECTIVENESS OF AN ONLINE STRATEGY FOR COLLECTING AND SCALING CRITICAL INCIDENTS. Carlotta M. Boone<sup>1</sup> & William O. Dwyer<sup>2</sup>, <sup>1</sup>Old Dominion University, Norfolk VA 23529 and <sup>2</sup>The University of Memphis, TN 38152. The Critical Incident Technique (CIT) is a well-known method for collecting job behaviors. This study investigated the efficacy of a Web-based strategy for generating critical incidents using an online procedure through which police supervisors were trained in the CIT and identified, categorized, and rated incidents involving police officers' behavior. Results indicated that eleven supervisors created 198 critical incident statements, 148 of which were suitable for subsequent categorizing and scaling. Supervisors later used an online survey to categorize each of the statements with respect to performance domain and rate each in terms of degree of effectiveness and importance. Ten incumbent officers also categorized and scaled the statements, and results indicated that their judgments were generally similar to those of their supervisors. A total of 35 of the statements survived the consensus requirements for both groups, combined.

DIFFERENCES IN EMOTIONAL INTELLIGENCE AND REASONS FOR ENROLLMENT IN COLLEGE FOR AMERICAN AND INTERNATIONAL STUDENTS. Veena A. Nair & Elaine M. Justice, Department of Psychology, Old Dominion University., Norfolk Va 23508. This study examined whether motivational factors for enrollment in college and emotional intelligence, were different for American and international college students. Forty international and sixty-three American students were recruited through non-probability sampling. Participants completed the Education Participation Scale (EPS) and the Self-Report Measure of Emotional Intelligence (SEI). The overall MANOVA showed significant differences between the two groups on the motivational factors for enrollment in college; the follow-up univariate ANOVAs were not significant. Independent t-test revealed no significant differences between the two groups on emotional intelligence. For the international students significant correlation was found between emotional intelligence and professional advancement. Implications and limitations of the study are discussed.

SEXUAL HARASSMENT ON CAMPUS: A STUDY OF WHITE AND MINORITY-GROUP FEMALE UNDERGRADUATE WOMEN. Jewelle L. Harmon, Dept. of Psychology, Old Dominion University, Norfolk VA 23529. Well-publicized allegations of sexual harassment, such as those involving Clarence Thomas and Anita Hill and the Navy's Tailhook scandal, have made sexual harassment a major issue of concern. Few investigators have examined the role of racial/ethnic background in women's experiences of sexual harassment. The present study assessed whether minority-group women attending a mid-sized university were more likely to view differently a specific type of sexual harassment than were White undergraduate women. In addition, the types of sexual harassment women experienced were compared. No significant differences were found. Future studies and limitations are discussed. Statistical data and tables are provided.

DETERMINANTS OF PATERNAL INVOLVEMENT IN CHILDCARE IN DUAL-EARNER FAMILIES WITH PRESCHOOL CHILDREN. Julie N. Jacobs & Michelle L. Kelley, Old Dominion University, Norfolk, VA 23529. Dual-earner parents ( $N = 84$ ) of preschool children enrolled in licensed childcare centers completed questionnaires that examined work and family variables as related to paternal involvement in three areas: engagement (i.e., one-on-one interaction with the child), responsibility (i.e., taking care of the child's needs), and accessibility (i.e., being available to the child without directly interacting). Regression analyses were performed in order to examine whether work and family variables predicted the amount of paternal involvement in the three areas of childcare. Fathers' reports of paternal involvement were significantly predicted by parenting self-efficacy, marital satisfaction, and fathers' beliefs concerning the parental role. Mothers' reports of paternal involvement were significantly predicted by marital satisfaction and mothers' beliefs concerning the parental role. These findings suggest that paternal involvement is greatly impacted by variables associated with both mothers and fathers.

INSTRUMENTAL STIMULUS DISCRIMINATION OF A CONSPECIFIC CHOICE IN *BETTA SPLENDENS*. Michael L. Suis, Andrea F. Velissarios, Alicia A. Burns, & Andrew J. Velkey II. Dept. of Psych. Christopher Newport University, Newport News VA, 23606. Instrumental Choice behavior in Siamese Fighting Fish (*Betta splendens*) was investigated. The discriminative stimulus (SD) was a blue checkerboard pattern placed on one choice door. Subjects were allowed to choose between an encounter with a conspecific (another live male) and a nonconspecific (nothing). The SD was expected to be associated with the presence of the conspecific. One fish demonstrated reinforcement, denoted by decreased swimway times, and treated the pattern as a conditioned reinforcer (S+). A second fish demonstrated reinforcement but treated the unmarked door as an S+. For a third fish, swimway times increased, denoting punishment. A fourth fish did not show a consistent choice pattern or stable swimway times. The disparate results may indicate that dominance plays a role in choice behavior.

ARE THESE JEANS MY SIZE?: EFFECTS OF MISLABELED SIZES IN EATING IN HIGH AND LOW SELF-OBJECTIFIERS. Angel I. Daniels & E. Maury Stegall, Dept. of Psychology, Washington and Lee University, Lexington VA 24450. Objectification theory asserts that society socializes women to adopt an outsider's perspective on their bodies, teaching them to treat themselves as objects to be evaluated on the basis of looks alone. A crucial outcome of the experience of self-objectification is the onset of body shame, which is often directly followed by restrained eating. The present study examines the effect of trying on clothing on women's restrained eating. Sixty undergraduate women tried on either normally sized jeans or mis-sized jeans, or rated advertisements, and immediately tasted cookies. The incidence of trying on mis-sized jeans was not found to induce restrained eating, nor was that of trying on jeans in general. Eating did not significantly vary among high versus low self-objectifiers.

"MEN AND WOMEN CAN'T BE FRIENDS BECAUSE THE SEX PART ALWAYS GETS IN THE WAY:" EXAMINING THE FREQUENCY AND IMPACT OF ATTRACTION IN OPPOSITE SEX FRIENDSHIPS. Jane Brodie Gregory. Washington and Lee University, Lexington, Virginia 24450. The current study seeks to examine the frequency and impact of attraction in opposite sex friendships. An undergraduate sample ( $N = 140$ ) completed subjective self report forms with questions pertaining to their close, opposite sex friendships. Participants also viewed sets of four photographs and completed a series of eight questions about the people in these photographs. All four research hypotheses about attraction and its effects on opposite sex friendships were confirmed. Significant differences were found between males and females for desire for sexual relations with opposite sex friends and the role of sexual attraction in friendship initiation. Male participants were significantly more likely than females to desire sexual relations with opposite sex friends. Level of attractiveness was more important in initiating opposite sex friendships for male participants than

females. Men were more likely to initiate friendships with highly attractive women than low attractive women.

**GENDER BIAS IN LANGUAGE: SO WHAT?** Elise E. Judd & Corinne Mathieu, Dept. of Psychology, Washington and Lee Univ., Lexington VA 24450. Do college aged students think to use gender neutral pronouns without prompting? Does gender or formality of context have an effect on gender neutral pronoun usage? This study presented 50 subjects with two formal and two informal excerpts for grammar correction. Twenty-seven subjects received an initial math problem containing the gender neutral pronoun *he/she* (previous literature shows this is the most gender neutral pronoun). Sex and whether or not the subject received the initial prompt had no significant effect on the percent of gender neutral pronouns used. Formality of context was a significant main effect: subjects used more gender neutral pronouns in the formal context than the informal context. Results indicate the need for further studies.

**LASSIE REVISITED: FACIAL EXPRESSIONS AND MIXED EMOTIONS.** Joy Whitehead, Tom Herbert, & Nancy Margand, Dept. of Psychology, Washington and Lee University, Lexington, VA 24450. Previous research on children's understanding of mixed emotions has found that children under the age of seven do not acknowledge the simultaneous experience of conflicting emotions and that children's understanding of mixed emotions is affected by the methods used to test their understanding. The present study replicated earlier studies on children's understanding of mixed emotions while using more visual, as opposed to verbal, methodology to assess understanding. After hearing stories designed to elicit mixed emotions, children were asked to 1) verbally acknowledge or deny the experience of multiple emotions and 2) use a visual representation of faces to indicate how much of each emotion they would feel in the given situation. Results showed that while children under seven did not verbally acknowledge experiencing conflicting emotions at the same time, they chose faces expressing conflicting emotions when presented with the visual measure. Results also indicated that children have the cognitive ability to understand mixed emotions between age 7 and 9 years of age, sooner than previously believed, and that their visual representation of this knowledge continues to be superior to their verbal knowledge.

**SYMPOSIUM: "...An Utterly Clear Perceptual Fact..." A Progress Report on Stimulus Clarity Research in the S. E. Asch (1956) Independence-Conformity Paradigm.**

**ASCH AND STIMULUS CLARITY: THE PROBLEM, PROTOCOL, AND METHOD.** Lauren K. Burt<sup>1</sup>, Cynthia L. Clifford<sup>1</sup>, Elizabeth S. Martin<sup>1</sup>, Gayle P. Lentz<sup>1</sup>, Brynn A. Wilmoth<sup>1&2</sup>, Enacio Freeman<sup>1</sup>, Andrea L. Atwell<sup>1</sup>, Sulaiman T. Bah<sup>1</sup>, Christina E. Oeming<sup>1</sup>, and James P. O'Brien<sup>1</sup>. <sup>1</sup>Tidewater Community College, Virginia Beach VA 23453 and <sup>2</sup>Old Dominion Univ. Schwabenbauer, Schwabenbauer, Larkin & O'Brien (1999) replicated Asch's 1956 experimental and control conditions with community college participants and same-sex peer experimenters. The present problem is derived from one of their findings: the frequency of erring participants in the control condition did not differ significantly from those in the group pressure condition. This is particularly perplexing because the Asch paradigm requires that the stimuli constitute "an utterly clear perceptual fact." A multiyear protocol to replicate control conditions for stimulus clarity, featuring a 2x2x2x2 factorial design with  $n \geq 37$ , was implemented. Variables include participants' sex and college (2-year vs. 4-year) and experimenters' sex and status (authority vs. peer). Hypothesis I states that subjects most like Asch's (White male 4-year undergraduates with a same-sex authority experimenter) will have higher % error-free and lower mean error measures. Hypothesis II states the opposite. The methodology presented describes the detailed training and guidelines necessary to acquire data over several years at two different colleges.

AN INVESTIGATION OF CONTROL CONDITIONS IN ASCH-TYPE EXPERIMENTS: IV. Gayle P. Lentz<sup>1</sup>, Elizabeth S. Martin<sup>1</sup>, Sulaiman T. Bah<sup>1</sup>, Andrea L. Atwell<sup>1</sup>, Lauren K. Burt<sup>1</sup>, Brynn A. Wilmoth<sup>1&2</sup>, Christina E. Oeming<sup>1</sup>, Cynthia L. Clifford<sup>1</sup>, Enacio A. Freeman<sup>1</sup> & James P. O'Brien<sup>1</sup>. <sup>1</sup>Tidewater Community College, Virginia Beach VA 23453 and <sup>2</sup>Old Dominion University. Pursuant to earlier protocol research (N=340) by Herrera, Mattingly, Hannah & O'Brien (2000), Craig, McGeehen & O'Brien (2001) and Isler, Clouser, & O'Brien (2002); a total of 185 Subjects were added to several of the 16 cells in Fall 2002 and Spring 2003. Three more cells were completed ( $n \geq 37$ ) for a total of 7. So far, no cell is equivalent to the high criteria of Asch's controls by which he verified stimulus clarity. Since Asch used female as well as male experimenters, the poor performance of our 4-year White men with a female authority experimenter suggests that his control subjects may have been inappropriate for comparisons to his Critical Subjects with female experimenters. Further, not a single Subject in the replication most similar to Asch's has committed two errors. This finding has implications for the relaxed criteria Asch used to categorize Critical Subjects as independent in his detailed analyses of interview responses (among "independents" were included those with 0, 1, 2, or sometimes 3 errors). No women see the Asch stimuli as clearly as his control Subjects.

IMPLICATIONS FOR THEORY AND RESEARCH. Andrea L. Atwell<sup>1</sup>, Brynn A. Wilmoth<sup>1&2</sup>, Christina E. Oeming<sup>1</sup>, Gayle P. Lentz<sup>1</sup>, Elizabeth S. Martin<sup>1</sup>, Lauren K. Burt<sup>1</sup>, Cynthia L. Clifford<sup>1</sup>, Sulaiman T. Bah<sup>1</sup>, Enacio A. Freeman<sup>1</sup> & James P. O'Brien<sup>1</sup>. <sup>1</sup>Tidewater Cmnty. Coll., Virginia Beach VA 23453; <sup>2</sup>Old Dominion Univ. Asch reacted to the behavioristic and psychoanalytic interpretations of persuasion studies done in 1920s-30s, objecting to their mechanistic and non-rational explanations of social behavior. Unlike previous studies using illusory or ambiguous stimuli and implied sources of persuasion, Asch's classic independence-conformity paradigm sought to establish a real dilemma between the utterly clear evidence of one's eyes and a physically present majority of 3 or more who err unanimously. Therefore, it is absolutely essential that Asch's stimuli constitute "an utterly clear perceptual fact." Although many of our White-male cells are not yet complete, only the condition most similar to Asch's can possibly approximate his control criteria within his  $n=37$ . Since men perform generally worse than Asch's controls and women perform worse than men, it appears that, contra to the literature, women in group pressure conditions err more than men for one reason -- the stimuli are less clear to them. As Asch demonstrated, stimulus ambiguity is associated with greater conformity. Age, ethnicity, and distance data will be analyzed; future research is described.

ETHNICITY IN ASCH CONTROL REPLICATIONS: AFRICAN-AMERICAN PEER EXPERIMENTERS AND COMMUNITY COLLEGE PARTICIPANTS. Sulaiman T. Bah<sup>1</sup>, Neysa L. Isler<sup>1&2</sup>, Natalie A. Clouser<sup>1</sup>, Andrea L. Atwell<sup>1</sup>, Gayle P. Lentz<sup>1</sup>, Elizabeth S. Martin<sup>1</sup>, Lauren K. Burt<sup>1</sup>, Cynthia L. Clifford<sup>1</sup>, Brynn A. Wilmoth<sup>1&3</sup>, Enacio A. Freeman<sup>1</sup>, Christina E. Oeming<sup>1</sup> & James P. O'Brien<sup>1</sup>. <sup>1</sup>Tidewater Cmnty. Coll., Virginia Beach VA 23453, <sup>2</sup>George Mason Univ. and <sup>3</sup>Old Dominion Univ. Just as Asch's proposal for using peer experimenters does not appear in the literature, so too the study of experimenters of minority ethnicity is absent. Yet, in unrelated studies, some investigators have shown better performance among Whites if the task administrator is Black. Based on the relatively poor performance of Subjects in the 16 cell paradigm; (1) it is necessary to establish error measures in the Asch control condition before experimental conditions are carried out, and (2) social identity theory and self-categorization suggest that White men and women may perform better with a Black experimenter. An African-American male or female peer presented Asch's stimuli to groups of community college students of mixed ethnicity and sexes. While no category of subjects performed as well as Asch's White male controls, there was some support for the predictions of enhanced performance among White women in comparison to similar cells in the main protocol with White experimenters.

### Statistics

(No abstracts submitted)

