

# PROCEEDINGS

## ABSTRACTS OF PAPERS, 80th Annual Meeting of the Virginia Academy of Science, May 22-24, 2002, Hampton University, Hampton, Virginia

### Aeronautical and Aerospace Sciences

(No Abstracts Submitted)

### Agriculture, Forestry and Aquaculture Science

ROW SPACING MANIPULATION AND GWOP CANOLA. Harbans L. Bhardwaj, Agricultural Research Station, Virginia State University, Petersburg, VA 23806. GWOP (Grown With Out Pesticides) canola (*Brassica napus*) has the potential to establish canola as an alternative crop for supplying healthy edible oil. Canola is generally planted in rows spaced 15 to 20 cm. This practice, precludes the use of mechanical cultivation and necessitates the use of herbicides for weed control. If canola could be produced by planting in wider rows without reducing the oil yield and quality, it would allow mechanical cultivation and facilitate organic production of canola. The results of a replicated field experiment, conducted during 2000-2001 season, indicated lack of statistical differences for seed yield, oil content in the seed, and oil yield for 15, 30, 45, 60, 75, and 90 cm row spacings (2898, 2413, 1943, 2180, 1963, and 2223 kg/ha; 38.5, 39.4, 40.0, 41.1, 39.4, and 40.1 percent; and 1106, 943, 776, 896, 771, 890 kg/ha, respectively). The fatty acid profiles were also not affected by row spacings, the total saturated fatty acids varied from 8.6 to 9.8 percent, total unsaturated varied from 90.2 to 91.4 percent, mono-unsaturated fatty acids varied from 65.1 to 67.2 percent, and poly-unsaturated fatty acids varied from 23.0 to 26.5 percent. The results indicated that canola can be grown by using any of the six row spacings evaluated in this study. Significance of these results lies in the fact that canola can be produced organically by using wide rows.

SULFUR FERTILIZER RATE EFFECTS ON CANOLA YIELD AND QUALITY. Ronald A. Bowen and Harbans L. Bhardwaj, Agricultural Research Station, Virginia State University, Petersburg, VA 23806. Efforts by Virginia State University (H.L. Bhardwaj) and Virginia Tech (D.E. Starner) have led to development of a canola production system which consists of planting in late September to middle October, use of 5-6 kg/ha seed, and use of 100 kg/ha each of nitrogen, phosphorus, and potassium. These efforts have also developed a new cultivar (VSX-1) which is adapted to this region. However, the information about use of sulfur fertilizer in canola production in Virginia is not available. A replicated field experiment during 2000-2001 season indicated that the sulfur fertilizer rate significantly affected the seed yield which varied from 1734, 1765, 2209, and 2705 kg/ha, respectively for 0, 15, 30, and 45 kg S/ha. The S rate effects on oil content were not significant but because of significant effects on seed yield, the oil yield was significantly affected by S fertilizer rates. The oil yield varied from 724, 745, 930, and 1097 kg/ha, respectively for 0, 15, 30, and 45 kg S/ha. The oil yield following 30 and 45 kg S/ha were statistically similar and were statistically superior to those following 0 and 15 kg S/ha. Effects of S fertilizer rates on fatty acid composition of oil were not significant. These results indicate that it may be desirable to apply 30 kg/ha of sulfur for highest canola oil yield in Virginia.

CHARACTERIZATION OF THE CHLORIDE CHANNEL-1 (CLC-1) GENE IN SHEEP WITH CONGENITAL MYOTONIA. Altamarie Woods & Brian L. Sayre, Agriculture Research Station, Virginia State University, Petersburg 23806. Myotonia is a condition that causes delayed relaxation of muscles after sudden contractions. In Myotonic goats, myotonia was caused by a single-point mutation in CIC-1 gene. This condition has also been observed in some sheep. The objective of this study was to determine if myotonic sheep had the same CIC-1 mutation. Jugular blood was collected from sheep that expressed the myotonic phenotype (myotonic; n = 3) and did not express the

myotonic phenotype (normal; n = 4). Genomic DNA was extracted from whole blood samples. A 177-bp fragment, that contained the CIC-1 mutation in goat, was amplified by PCR, and products were subjected to Mbo II restriction enzyme digestion. After Mbo II digestion, two fragments (105 and 72 bp) were found, similar to that found in normal goats. There were no differences in the digested fragment pattern between normal and myotonic sheep. The single-point mutation related to myotonia in the goat was apparently not present in the myotonic sheep. Further characterization of the CIC-1 gene in the myotonic sheep may result in the discovery of a different mutation that leads to the myotonic phenotype, and further our understanding of congenital myotonia in animals and humans.

TWO YEAR SUMMARY OF GOLDEN TROUT IN WINTER CAGE CULTURE. Scott H. Newton, Cooperative Extension, Virginia State University, Petersburg, VA 23806. Golden trout, a genetic color variation of rainbow trout, were reared in side by side cage trials with rainbow during the fall to spring seasons of 2000-2001 and 2001-2002. Golden trout survival was 91% and 85% while rainbow trout survival was 92% and 79%, respectively for the two seasons. Average overall weight gains and feed efficiencies between the two strains were not significantly different. Therefore, it appears at this point that selection of which strain to produce may be more closely related with marketing and sales than rather than significant production differences. A third season of production comparisons between golden and rainbow trout will be conducted during the fall to spring season of 2002-2003.

IMPORTANT STEPS IN AQUACULTURE NUTRITION RESEARCH. Craig S. Kasper, Virginia Cooperative Extension, Virginia State University, Petersburg VA 23806. Aquaculture production must expand to keep up with increasing demand for fish. Increasing aquaculture production will provide food, alternative markets for agriculture products and supplement stocks used in recreational fisheries. Fish nutrition is of critical importance to aquaculture production, especially when confronted with new species. Determining natural food preferences will help to facilitate feed production and stimulate industry growth. Practical diets formulated from known nutrient requirements and manufactured utilizing low-cost, readily available oilseeds, can help to reduce variable costs of feed in fish production by conserving expensive fish meal and increase aquacultural production while improving environmental quality and fish health.

PRELIMINARY FINDINGS ON EFFECTS OF ENERGY TO PROTEIN RATIOS IN YELLOW PERCH (*Perca flavescens*) S.R. Craig<sup>1</sup> and E. McLean<sup>2</sup> <sup>1</sup>Virginia/Maryland Regional College of Veterinary Medicine, VPI&SU and <sup>2</sup>Department of Fisheries & Wildlife Sciences, VPI&SU. Results from a preliminary trial investigating the effects of different protein to energy ratios on weight gain and biological indices of yellow perch (*Perca flavescens*) was performed in a recirculating system consisting of 10 gallon glass aquaria. Experimental diets with energy to protein ratios ranging from 6 to 14 were fed to triplicate groups of yellow perch (n=8/aquaria) for 10 weeks. Yellow perch fed the diets containing the highest energy to protein ratios (11.2 and 14.8) had significantly reduced weight gain compared with fish fed the diets with energy to protein ratios under 10, which all had similar weight gain. Biological indices measured included hepatosomatic index (HSI), intraperitoneal fat (IPF) ratio and visceral mass index. No significant dietary effects were observed on the biological indices measured, although yellow perch fed the diets with higher energy to protein ratios tended to have larger HSI. All fish in the present study had significant lipid deposition as measured by the IPF ratio, with fish in all treatments having at least an IPF ratio of 4 or higher. Further refinement of the energy to protein ratio in this species is warranted.

PRELIMINARY RESULTS OF SOUTHERN FLOUNDER (*Paralichthys lethostigma*) FRY PRODUCTION IN RECIRCULATING AQUACULTURE SYSTEMS (RAS). M. H. Schwarzl<sup>1</sup>, R.W. Cool<sup>1</sup>, D.E. Mowry<sup>1</sup>, S.R. Craig<sup>2</sup>, E. McLean<sup>3</sup>, and M.L. Jahncke<sup>1</sup>. <sup>1</sup>VSAREC 102 S. King

Street, Hampton VA, 23669, <sup>2</sup>College of Veterinary Medicine, VPI&SU, and <sup>3</sup>Department of Fisheries & Wildlife Sciences, VPI&SU. Results from the preliminary trial of southern flounder fry production in RAS at the Virginia Seafood Agricultural Research and Extension Center (VSAREC) were positive. From 19,000 eggs, 15,000 southern flounder fry were hatched. Upon hatching, fry were placed into a "greenwater" RAS. Greenwater production techniques included: 1) larval fish densities of 30/ml, 2) live algal densities (a combination of *Nannochloropsis* sp., *Isochrysis* sp., and *Tetraselmis* sp.) of 300,000 cells/ml, 3) rotifer densities (*Brachionus* sp.) in excess of 15/ml, and 4) artemia (*Chirocephalus* sp.) densities of 2-4/ml. After placement into the greenwater system (one day post-hatch) the fry quickly grew to metamorphosis by day 40, at which time they were placed onto commercially available dry feeds. At metamorphosis, a survival rate of 73% from hatching was observed. A secondary trial of fry production under similar protocols is presently under way with summer flounder (*Paralichthys dentatus*).

REVIEW OF BARLEY STRAW FOR ALGAE CONTROL. Brian L. Nerrie, Coop. Ext., Virginia State Univ., Petersburg, VA 23806. Algae are one of the primary producers in the aquatic environment, serving as a food source and provider of dissolved oxygen. However, excess algae can be problematic, impacting on aesthetics, water quality, and the valued uses of the aquatic resource. Aquatic managers are requesting new alternative algae control methods. Chemical herbicides are still widely used, but can result in water use restrictions. Overuse of chemicals is a concern. Copper, the most widely used herbicide ingredient for controlling algae, is relatively safe, but under low alkalinity conditions, can be highly toxic to fish, especially trout. Barley straw was shown during the 1990s to inhibit algae growth in Great Britain. Hydrogen peroxide, one of the products of decay, is suspected of being the algae inhibitor. Barley straw has been adopted by water gardeners in the United States for use as an algae control agent. Managers of ponds and lakes are examining its potential. Proper estimates of surface area are necessary. Barley straw is packed loosely into sacks at 90-225 kg/ha. Straw sacks are maintained in the top meter of water allowing flow through the straw. The straw is effective for up to 6 months at water temperatures exceeding 20° C. The Virginia Fish Farmers Association and Virginia State University are conducting a SARE funded study using barley straw.

IMPACT OF FEEDING ON DISSOLVED OXYGEN CONCENTRATION IN RAINBOW TROUT CAGE CULTURE. Tony J. Robinson & Brian L. Nerrie, Dept. Agriculture and Home Ecology, Virginia State Univ., Petersburg, VA 23806. Several Virginia fish farmers are double cropping ponds by feeding warm water fish (catfish, hybrid striped bass) during warm water temperatures and cold water fish (trout) during cold water temperatures. Cold water fish such as rainbow trout (*Onchorhynchus mykiss*) cannot survive temperatures that exceed 22° C for extended periods of time. Cage culture is a production technique by which fish are stocked at high density and fed a complete diet in a cage floating just below the surface. Rainbow trout were stocked at 300 fish per 1.7 m<sup>3</sup> cage in cages located in an aerated 0.05-ha pond at Virginia State University's Randolph Farm Aquaculture Facility during the winter growing season of 2001-2002. Cages were constructed from 1.25-cm mesh plastic mesh. This study examined the impact of feeding activity on the dissolved oxygen concentration (D.O.) inside the trout cage. Trout were offered a 4-mm floating trout pellet at 1% body weight. D.O. measurements were taken at the surface and bottom of the cage before feed was offered and 15 minutes post-feeding. Water quality parameters (alkalinity, hardness, and temperature) were maintained within the range for trout production. Feed activity reduced the D.O. inside the cage surface water by an average of 9.5 % following initial feed consumption.

HIGH DENSITY INTENSIVE ROTIFER CULTURE FOR THE FIRST FEED STAGE OF JUVENILE SOUTHERN FLOUNDER (*Paralichthys lethostigma*). R. W. Cool, M. H. Schwarz, M. L. Jahncke, D. E. Mowry, Virginia Seafood Agricultural Research and Extension Center (VSAREC), 102 S. King Street, Hampton, VA 23669. As with any finfish, the first-feed stage of juvenile southern flounder is the most critical period in the fish's life. The southern flounder is a sight

feeder with very little propulsion skills. They rely on aeration currents to move throughout the system as juveniles. Adequate feed in a system is a crucial requirement to fulfill the nutritional needs of these juvenile fish in their pre-metamorphosis stage. The first live feed for the juvenile southern flounder is the marine rotifer (*Brachionus plicatilis*), an aquatic zooplankton, which can be challenging to maintain at required densities. Intensive, high-density rotifer culture is the backbone for high survival rates of first-feeding stage larval fish. Culture parameters and techniques need to be easily maintained to produce ~1,000 rotifers/mL during spawning season. Maintaining 15-30 rotifers/ml in a larval system can be a tedious chore with the voracious feeding characteristics of flounder. High-density rotifer cultures are a necessity to fulfill the critical weaning stage and attain high survival rates with juvenile flounder.

AQUACULTURE ASPECTS OF BAIT RAINBOW TROUT PRODUCTION. Scott H. Newton and Craig S. Kasper, Cooperative Extension, Virginia State University, Petersburg, VA 23806. Holding and selling of small rainbow trout for live bait to recreational fisheries is a new opportunity for fish farmers in Virginia. Regulations allowing sale of rainbow trout for bait was granted in January, 2001. Two seasons of aquaculture experiments have been conducted to evaluate biological aspects of holding small trout in cages and tanks prior to transportation to bait dealers. The primary condition factor affecting this activity is variable water temperatures. Differences in water temperatures during handling and transportation of small trout is the primary biological challenge of this research. Management of bait trout in cages for live sales during spring appears biologically feasible.

PHYTONUTRIENTS INTERACTIONS AND POTENTIAL HEALTH BENEFITS: SOY PHYTOCHEMICALS AND PROBIOTICS. A. Ali<sup>1</sup>, A. Mohamed<sup>1</sup>, S. J. Bhatena<sup>2</sup> & M. T. Velasquez<sup>3</sup>, <sup>1</sup>Department of Biology, VSU, <sup>2</sup>BHNRC/ARS-USDA, Beltsville, MD and <sup>3</sup>George Washington Medical Center, Washington DC. This study was employed to test the hypothesis that the probiotics enhance the absorption of soy isoflavones and increase their biologically active metabolites. Lean and obese SHR/N-cp rats were fed diets containing either 20% casein (control), or 20% casein with either 0.1% isoflavones (I), or 0.1% probiotics (P) containing *Lb. acidophilus* (LA140), *Lb. casei subsp. casei* (LC107) and *Bifidobacterium bifidum* (BBL730), or a mixture 0.1% isoflavones and 0.1% probiotics (IP) for 20 weeks. Plasma was analyzed for metabolic and enzymatic parameters. I diet, with or without P diet, decreases weight gain and total body fat in both lean and obese rats. I containing diet decreased plasma glucose and cholesterol in lean and obese rats compared to the P and control. Plasma level of creatinine, blood urea nitrogen, uric acid, aspartate aminotransferase and alanine aminotransferase decreased in the lean and obese rats fed I and IP diets. These results indicate that I diets with or without P diet have differential effects on the plasma parameters and body weight and therefore may be effective in reducing obesity. P diet do not appear to enhance the effect of I diet.

THE PROSPECTS FOR SWEET CORN IPM IN VIRGINIA. Mark Kraemer & Carl Niedziela Jr., Agricultural Research and Extension, Virginia State University, Petersburg, VA. Fresh sweet corn is an important summer crop, especially after the establishment of two new farmers markets in eastern Virginia. However, commercial production requires high quality corn ears, at least 90% free of insect or other damage. Corn earworm is the major threat and producers have been known to apply insecticide 3 or more times a week during the 3 week period from first silk to harvest. We tested an IPM approach developed for the northeastern region. Pheromone traps are used to monitor pest populations and time insecticide applications. Each treatment plot consisted of 6 rows of corn, 50 feet long. Treatments were: spray every 3 days, every 5 days, IPM timed, and an unsprayed control. A pyrethroid pesticide, Warrior®, was used. The experiment was repeated over 3 years using 4 or 5 replicates. Corn earworm was the most serious pest, damaging over 90% of the untreated ears. Sap beetles were a primary pest, capable of significant damage. European corn borers were present but not a major problem. Although an IPM monitoring program in southeastern Virginia may reduce

insecticide treatments by 1 or 2 sprays in most years it is questionable whether it is cost effective in Virginia where temperatures are higher and corn earworm populations are greater than in regions farther north.

POTATO LEAFHOPPER (HOPMOPHTERA: CICADELLIDAE) IN GLANDULAR-HAIRED ALFALFA: PEST DENSITIES, YIELDS, AND FORAGE QUALITY. T. A. Dellinger, R. R. Youngman, & C. A. Laub, Dept. of Entomology, VPI&SU, Blacksburg, VA 24061. Commercial varieties of glandular-haired (GH) alfalfa have been marketed as having resistance to the potato leafhopper (PLH) (*Empoasca fabae* Harris). Pioneer '54H69', a GH cultivar, and Southern States 'Choice', a standard non-GH cultivar, were seeded in Montgomery Co. and Campbell Co., VA, in 1999 to evaluate the role of GH alfalfa within alfalfa pest management. Plots were planted in a randomized complete block design with four combinations of insecticide-treated and untreated '54H69' and 'Choice' cultivars. Treated plots received insecticide application for PLH regardless of pest pressure in order to approximate calendar spraying conducted by growers. Overall, '54H69' did not appear to offer any distinct advantages over 'Choice'. Variety had no effect on PLH densities except at Montgomery Co. in 2000, when significantly fewer nymphs were found in '54H69'. A slight but significantly higher percentage crude protein was found in '54H69' in that year only. Variety had little effect on dry yields. Surprisingly, insecticide application reduced pest pressure but did not necessarily improve yields or forage quality.

CURRENT RESEARCH ON SOYBEAN: OBESITY AND DIABETES. A. I. Mohamed<sup>1</sup>, S. J. Bhatena<sup>2</sup>, A. A. Ali<sup>1</sup>, & M. T. Velasquez<sup>3</sup>, <sup>1</sup>Department of Biology, VSU, <sup>2</sup>BHNRC/ARS-USDA, Beltsville, MD and <sup>3</sup>George Washington Medical Center, Washington DC. Soybean (S) have been reported to have beneficial effects on chronic diseases, including cancer, cardiovascular disorders, and renal disease. We tested the hypothesis that S also has beneficial effect on obesity and diabetes. Lean and obese SHR/N-cp rats were fed diets containing either 20% casein, or 20% S for 26 weeks. Lean rats were hypertensive while obese rats show genetic characteristics of type II diabetes. Obese rats had significantly higher plasma glucose (G), triglyceride (TG), total cholesterol (C), HDL cholesterol (HDL-C) and LDL cholesterol (LDL-C). S significantly decreased C and LDL-C in both lean and obese rats. It had no significant effect on G. S had varying effects on tissue weights in lean and obese rats. Obese rats compared to lean rats, had significantly lower plasma creatine but higher total bilirubin (BIT), blood urea nitrogen, alanine aminotransferase (AT) and lactate dehydrogenase (LDH). S diet decreased BIT, AT, protein and uric acid in lean rats, but the effects in obese rats were mixed. In conclusion, S diet has beneficial effects on metabolic and enzymatic parameters and may play a role in reducing complications of obesity.

EFFECT OF CALCIUM NITRATE CONCENTRATION ON THE GROWTH AND FLOWERING OF DUTCH IRIS (*Iris hollandica*) IN THE FLOAT SYSTEM. C.D. Mullins<sup>1</sup>, C.E. Niedziela Jr.<sup>1</sup>, T.D. Reed<sup>2</sup>, & A. Atalay<sup>1</sup>, <sup>1</sup>Va. Coop. Ext. & Agric. Res., Va. State Univ., Petersburg, VA 23806 & <sup>2</sup>Southern Piedmont AREC, Va. Polytechnic Inst. & State Univ., Blackstone, VA 23824. Dutch iris 'Ideal' bulbs were planted on 30 Oct. 2001 in a tobacco transplant greenhouse in either 32-cell polystyrene trays or lay-flat bags containing tobacco germination media and harvested as cut flowers. The four treatments were lay-flat bags irrigated weekly with a Ca(NO<sub>3</sub>)<sub>2</sub> solution at 400 mg N·L<sup>-1</sup> and polystyrene trays floated on Ca(NO<sub>3</sub>)<sub>2</sub> solutions maintained at 50, 100, and 200 mg N·L<sup>-1</sup>. Treatments were randomized in a Latin-square design with four replications of each system and means separated by least significance difference. Days to first harvest were shorter in lay-flat bags (47 d) compared to float treatments (50 d). Harvest duration was shorter in lay-flat bags (17 d) than float trays at 50, 100, and 200 mg N·L<sup>-1</sup> (44, 42, and 42 d, respectively). Stems from the lay-flat bags (22.8 g) were heaviest, followed by 50 mg N·L<sup>-1</sup> float trays (21.2 g), then 100 and 200 mg N·L<sup>-1</sup> float trays (19.8 g). Stems in the 200 mg N·L<sup>-1</sup> float trays (72 cm) were longer than the lay-flat bags (58 cm). On 4 Dec 2001, there were no significant differences in N, P, K, Mg, and Ca in shoot tissue.

DETECTING *STREPTOCOCCUS* IN TILAPIA FROM COMMERCIAL AQUACULTURE SYSTEMS. David Crosby, Cooperative Extension, PO Box 9081, VSU, Petersburg, VA 23806. *Streptococcus* is an emerging pathogen of tilapia in tanks utilizing recirculating aquaculture systems (RAS) technology. The fish losses caused by *Streptococcus* worldwide are estimated at \$150 million. Recent US surveys have shown that the prevalence of *Streptococcus* in tilapia is about 4 percent. This project looks at detection protocols used for inspecting tilapia for *Streptococcus*. The present inspection protocol for recovering *Streptococcus* from tilapia requires a sixty fish sample with isolates coming from the skin of the fish and inoculated on CNA 5% Blood Agar for 48 hrs at 35° C. Since 1996, Virginia State University (VSU) Fish Health Diagnostic Laboratory has not recovered *Streptococcus* during an inspection of tilapia. However, VSU Fish Health Lab has recovered *Streptococcus* from tilapia exhibiting mortalities in tanks: one case in 2000 and two cases in 2001. As part of the inspection protocols, a routine check is conducted for external parasites. *Ichthyobodo* was the most prevalent protozoan parasite found on tilapia. The prevalence of *Ichthyobodo* on tilapia ranged from 25% to 57%.

PRELIMINARY RESULTS FROM THE USE OF HYDROGEN PEROXIDE IN RECIRCULATING AQUACULTURE SYSTEMS WITH SUMMER FLOUNDER (*Paralichthys dentatus*). David E. Mowry, M.H. Schwarz, R.W. Cool and M.L. Jahncke. Virginia Seafood Agricultural Research and Extension Center, 102 S. King Street, Hampton, VA 23669. Hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) is a compound used for therapeutic control of external diseases of cultured fish. Considered a low regulatory priority by the U.S. Food and Drug Administration (FDA), many other uses of hydrogen peroxide, in aquaculture, are being developed. Hydrogen peroxide also acts as an oxidizing agent, removing dissolved organics from the water column. Research conducted at the Virginia Seafood Agricultural Research and Extension Center (VSAREC) compared the efficacy of hydrogen peroxide versus protein skimming in recirculating aquaculture systems. Six, 480 gallon independent replicated systems, three with H<sub>2</sub>O<sub>2</sub> and three with protein skimmers, were stocked with twenty-nine summer flounder averaging 480 grams/fish. Hydrogen peroxide was added, via IV drip, based on organic loading of feed input. Total suspended solids and bacterial counts were sampled weekly. Weight gain was assessed every three weeks. Preliminary assumptions suggest that hydrogen peroxide was less effective than protein skimming.

CLINICAL PRESENTATIONS OF *MYCOBACTERIUM* SP. IN SUMMER FLOUNDER (*PARALICHTHYS DENTATUS*) HELD IN RECIRCULATING AQUACULTURE SYSTEMS. Kathleen P. Hughes and Stephen A. Smith, Aquatic Medicine Laboratory, Dept. of Biomedical Sciences and Pathobiology, Virginia-Maryland College of Veterinary Medicine, VPI&SU, Blacksburg, VA, 24061. A population of 1000 commercially-reared juvenile summer flounder was housed in recirculating systems for approximately one year. After six months, fish began to develop oral masses on the lower mandible. These discrete masses were generally white-yellow in color and encompassed the rostral portion of the mandible. In addition, fish developed head swelling, exophthalmia, coelomic distention and opercular masses. It was estimated that at least 40% of the entire population displayed one or more of these clinical signs. Impression smears and histopathology of these lesions (stained with Ziehl Neelsen acid-fast stain) revealed a dense population of acid-fast bacilli. All affected tissues had marked effacing and coalescing granulomatous inflammation primarily composed of epithelioid macrophages. This tissue reaction was not the typical teleost granulomata response to *Mycobacterium* sp. Bacterial cultures from the affected tissues grew on Lowenstein-Jensen and Middlebrook media and were confirmed to be acid-fast positive with Ziehl Neelsen staining.

**Archaeology**  
(No meeting this year)

**Astronomy, Mathematics and Physics**

PHOSPHONATE-BASED MONOLAYERS ON GaAs AND ITO. Karen Bland, Sharon E. Koh, & Chris Hughes, Dept. of Physics, James Madison University, Harrisonburg, VA 22807. We have demonstrated the formation of self-assembled monolayers (SAMs) of organo-phosphonates on GaAs (100) and (Indium, Tin) Oxide (ITO) surfaces. Monolayers of Octadecylphosphonic acid (ODPA) were formed by immersion of the materials in a millimolar solution for more than 20 minutes. The presence of the monolayer was confirmed by both X-ray Photoelectron Spectroscopy and contact angle measurements. Water contact angles of over  $110^\circ$  confirm nearly complete coverage of the surface by the monolayer. The contact angle does not change significantly over a period of several months of air exposure indicating that these monolayers are very robust. We also demonstrated the modification of the electronic properties of the ITO surface by phosphate monolayers by measuring the work function by photoelectron spectroscopy and Kelvin probe.

CONSTRUCTING WEB-BASED SCIENCE SIMULATIONS. Richard L. Bowman, Dept. of Physics, Bridgewater Col., Bridgewater, VA 22812. Since 1997 the web site, "Interactive Science Activities on the Web" (ISAW), has been under development as a home for simulations relating to physics and astronomy. The goal has been to present simulations that are visualizations of concepts that are not easily illustrated by in-class demonstrations or laboratory experiments, that are interactive so as to enhance student learning, and that are web-based and thus essentially independent of the type of computer used or the browser invoked to run the simulations. With this last criteria in mind, the simulations are written in standard HTML and JavaScript. Web forms and cookies are used to accept values of data chosen by the user which can then be passed to the code in the next-generated web page. A new simulation, "Finding Exoplanets," has recently been added to the site. The two previously active simulations ("Interactive Investigation of the Shapes of Planetary Orbits" and "Interactive Fractal Generation Using Iterative Function Systems") have also been dramatically revised. Each simulation has an associated on-line exercise to guide students in learning from the simulation. ISAW is available on the Internet at:  
<http://www.bridgewater.edu/departments/physics/ISAW/>

PROPAGATION CHARACTERISTICS OF MAXWELL'S EQUATIONS. A. Martin Buoncristiani, Dept. of Physics, Computer Science and Engineering, Christopher Newport Univ., Newport News, VA 23606. In studying the propagation of light through the non-linear optical material KTP (potassium titanyl phosphate, an orthorhombic crystal with unit cell dimensions in the ratios 1:1.66:2.00) I discovered anomalies in the standard numerical algorithm for the direct solution to Maxwell's equations (ME) due to Yee. These anomalies result from the assumption, frequently made in this type of numerical analysis, that ME are over specified and hence it is possible to use only the six curl equations to determine the six components of the propagating electric and magnetic fields. The remaining two divergence equations can either be ignored or used after the computation to check on the consistency of the numerical solution. It is possible to give a rigorous (but not particularly intuitive) proof that the assumption that Maxwell's equations are over specified is not correct. I want to present here a simple constructive proof of this for the case of propagation in a vacuum. This construction delineates the different polarization states of the propagating fields and it suggests a basis for a new algorithm. Generalization of these results to the case of propagation in general matter is described and an improved algorithm for the numerical solution of ME in complex media is given.

GENERATION OF PRIME CHAINS HAVING ACCELERATED GROWTH IN NUMBER OF DIGITS. Charlie H. Cooke, Department of Mathematics and Statistics, Old Dominion Univ., Norfolk, VA 23529. Available numerical evidence shows that the longer chains of Cunningham primes have the last digit of each element fixed. It is shown how to generate prime chains that have this fixed digit character but which have a more rapid growth in the number of digits per element per iterative step. Computer implementation is limited by the necessity of memory chaining.

ANALYSIS OF SURFACE AND ELECTRICAL PROPERTIES OF BONDER TIP MATERIALS. Zachary R. Kostura and Gerald R. Taylor, MSC 7702, Department of Physics, James Madison University, Harrisonburg, VA 22807. The production of microelectronic components uses bonding techniques in which an electric current passes through a resistive metallic tip to increase its temperature. The cyclical nature of this process causes tip wear that affects the quality of the electrical junctions produced. This paper presents the results of an investigation of the correlation between changing surface and electrical properties of bonder tip materials and the number of electro-mechanical cycles the tip material has undergone. Temperature variations in the transient electro-mechanical bonding process were observed using infrared techniques. Surface properties of tip material at specific cycles were determined using various microscopy techniques, including optical observations and scanning electron microscopy. Electrical properties at different position on the bonder tips were measured using four-probe resistance techniques. The results of this investigation and the inherent effects of these changing materials properties on the manufacturing environment in the production of microelectronic junctions are discussed. This research was supported by a Virginia Academy of Science Undergraduate Research Grant and by the JMU Center for Materials Science.

FIRE, ICE, WATER, AND DIRT: A SIMPLE CLIMATE MODEL. John Kroll, Dept. of Mathematics and Statistics, Old Dominion University, Norfolk, VA. 23529. The purpose was to develop a simple climate model as a modeling exercise. The spirit was to add a few more simple concepts to combine the simplicity of a toy climate model such as that of Posmeteir with the concept of "Daisy World" of Sanders. No really expert knowledge of climatology was invoked, but rather elementary concepts of physics of heat were used. Though the model is crude, the results are surprisingly realistic.

TECHNIQUES: THE ANALYSIS OF PHOTOMULTIPLIER TUBES. Jason C. Mace & Kevin L. Giovanetti James Madison University. Photomultiplier tubes are used in a wide range of applications. Ever since scintillation detectors became commonplace in particle physics research, photomultiplier tubes have been devices that physicists have tried various ways to characterize. In this talk a brief overview of James Madison's detector characterization laboratory will be given along with an introduction to photomultiplier tubes. Presentation will be made concerning the crucial features of photomultiplier tubes in a timing experiment. Furthermore results of TDC and ADC measurements of the single photon peak will be discussed as a way to analyze the intrinsic time of photomultiplier tubes. Future measurements and experimental design techniques will also be presented.

IMPLEMENTING CELESTIAL MECHANICS IN LAHEY FORTRAN. Charles E. Martin & Joseph W. Rudmin, Dept. of Physics, James Madison Univ. Harrisonburg, VA 22807. A brief introduction to the theory and usage of the Parker-Sochacki method of numerically solving systems of differential equations is presented. An example is offered by way of the method's application to solving the differential equations that model the motion of a large amplitude pendulum. In addition, the relevance of the method to solving the differential equations of motion for the planets of the solar system is discussed, along with an overview of a Lahey Fortran program that implements the results. Emphasize is placed on the computational power that results from combining numerical algorithms derived from the Parker-Sochacki method with the computational speed of modern computers.

CORRELATIONS BETWEEN POLLING SCORES, AP EXPERIENCES AND OVERALL GRADES IN INTRODUCTORY PHYSICS COURSES. William W. McNairy, Dept. of Physics, Duke University, Box 90305, Durham, NC 27708-0305 (mcnairy@phy.duke.edu). Recent data obtained from introductory Physics courses (one for Life Sciences majors and one for Engineers) reveal interesting correlations between polling scores, AP experiences and the overall grades earned in the courses. In the lecture part of these courses each student employs an infrared polling device (Personal Response Systems [PRS]) to respond to questions asked by the lecturer. Conceptual and



computational questions are presented that relate to reading assignments, to examples worked in lecture and to demonstrations that have been (or will be) done for the students. Some questions are repolled without display of the initial distribution of answers in order to encourage 'peer instruction' between the students. PRS scores were based upon the frequency, not the correctness, of the responses. Analysis of this data reveals interesting differences between the two student populations. I will also present correlations between prior physics coursework done in high school (as demonstrated by AP level exams on either the B or C levels), the PRS scores, and the overall grades. Dr. Lawrence Evans of this department has provided invaluable support in the development of this analysis.

DEVELOPMENT OF A BRIDGMAN CRYSTAL GROWTH FACILITY FOR II-VI SEMICONDUCTORS. O. Poku, Ei Ei Nyein, A.G. Bluiett, & U. Hommerich, Hampton University, Department of Physics, Hampton, VA 23668. The development of mid-infrared (MIR) laser sources is of great current interest for applications in laser remote sensing and medicine. The newest class of MIR solid-state lasers is based on  $\text{Cr}^{2+}$  doped II-VI semiconductors. Jointly with Brimrose Corporation of America, researchers at Hampton University have demonstrated lasing around 2500 nm from Cr: CdMnTe and Cr: CdTe. In an effort to optimize these materials and to explore other Cr based laser crystals, a new Bridgman crystal growth facility has been developed at Hampton University. Three Bridgman stations with computer-controlled translation mechanisms are currently operational. Each crystal growth station uses a three zone-furnace in order to fine adjust the furnace profile for optimization of the crystal growth process. The first successful growth of undoped and Cr doped CdTe materials will be described in this presentation.

ANALYSIS OF YEAR LONG ELF DATA WITH A DISCUSSION OF SOURCES, PERIODS AND LARGE SINGLE EVENTS. Michael Wallace & John Wallace, Hampden-Sydney College and Casting Analysis Corporation. The ELF Spectrum (1-1230 Hz) is a turbulent region of the electromagnetic spectrum. Geomagnetic Storms and UV radiation cause the ionosphere's properties to change drastically over time. With a narrow band, low noise receiver and two induction coils oriented in the cardinal, magnetic directions, magnetic field data was obtained at fourteen frequencies for ten months. The data shows at low frequencies geomagnetic storm polarization favors the east-west direction more than the north south. In the Fourier transform of the data, Periods greater than one day modulate the daily period raising the amplitudes around the daily peak above zero. A characteristic  $1/f^2$  fall of in the amplitude occurs due to simultaneous variations in both the conductivity and electric fields of the ionosphere of which both properties have  $1/f$  dependencies. After plotting a spectrum with periodic data, a maximum at two hundred hertz appears which is a lower cut-off in the band.

PARTICLE ACCELERATOR CALIBRATION SYSTEMS. Andrew W. Werner & Kevin L. Giovanetti, Department of Physics, James Madison University, Harrisonburg, Va. 22807. The  $\mu\text{Lan}$  collaboration is an effort to determine the lifetime of the muon to one part per million. This will be a significant improvement over the current accepted lifetime of about 60 parts per million. In July the collaboration has about a month of muon beam time in Switzerland. For the data collected in the detector to make sense we first need a working, reliable calibration system. The detector is shaped like a soccer ball, comprised of pentagons and hexagons which are in turn comprised of five or six triangles. For each triangle there are two sets of scintillators, light guides, and photomultiplier tubes. The scintillators absorb in the UV (approx. 350 nm) and emit blue photons (approx. 410 nm). In the calibration system we emulate actual conditions with light emitting diodes (LEDs). Also of concern is the pulsing of these LEDs in order to have them emulate experiment situations as well. For this we need a pulse with only a few nanosecond width that can be run at frequencies of about 15 kHz. We are using a modified version of the KamLAND pulser created by their calibration group. With our modifications these pulsers will create the reliable yet versatile calibration system that this experiment depends on.

THE EFFECT OF PERCENTAGE OF SOLID CONTAMINANT IN A LIQUID SOLUTION ON THE VELOCITY AT WHICH THE SOLUTION PASSES THROUGH A SINGLE-LEAF FILTER SYSTEM. Xun Zhou, Manchester Middle School, Richmond, Va. 23235. Corrosion of the filter leaf is the main cause of the degradation of filters. The effect of this build up of contaminant particles on the velocity of the fluid traveling the filter is apparent in the function of fluid velocity vs. time (an inverse bell curve). This experiment was conducted to find a method of measuring the amount of contamination in a filter using the velocity of the fluid passing through the filter. It was hypothesized that if distilled water was sent through a GE SmartWater<sup>®</sup> Filter in which the percentage of granular sand contamination was altered (0%, 5%, 10%, 15%, 20%), the rate of change could be expressed algebraically, along the lines of  $\Delta V = N/C$  (the velocity of the water is proportional to the number of pores in the filter over the percentage of contamination). The hypothesis was partially correct (the actual graph was similar to the hypothesis), but not completely. A more suitable equation is  $\Delta V = -0.1162C + 0.5275$ . The difference from the hypothesis was due to the interference caused by other constants and variables that were unaccounted for. Further experimentation could be conducted to determine these other factor's attributes.

### Biology

THE EFFECTS OF AZASERINE ON THE P53 GENE IN BREAST CANCER CELLS CRL-2314. Monica A. Bintz & Rosemary Barra. Dept. of Biol. Sci., Mary Washington College, Fredericksburg, VA 22401. Cytotoxic amino acid analogues including azaserine, an antagonist of L-glutamine, have shown anti-tumor activity in a number of studies. *In vitro*, this antimetabolite is a potent inhibitor of several glutamine-dependent aminotransferases, resulting in inhibition of *de novo* purine biosynthesis. In addition, azaserine acts as a carboxymethylating agent producing N7-carboxymethylguanine-DNA and O<sup>6</sup>-carboxymethylguanine-DNA. The tumor suppressor gene, p53, is often referred to as the guardian of the cell. It can trigger mutated cells to stop their progression through the cell cycle, giving the cell an opportunity to repair the DNA damage. When the cell is unable to repair the damage, p53 will trigger apoptosis. The purpose of this study was to determine the cytotoxic activity of azaserine against CRL-2314 breast adenocarcinoma cells and to determine the effects of the drug on the expression of the p53 gene. The MTT cytotoxicity assay indicated that a 24 hour incubation with 1 $\mu$ g/ml of azaserine reduced cell viability 72% and immunoblot analysis indicated an increased expression of p53. These results suggest that DNA lesions may be involved in the cytotoxic activity of azaserine in CRL-2314 cells.

STUDY OF TELOMERASE PROMOTER REGION IN A PROSTATE MODEL SYSTEM. Patrick C. Sachs<sup>1</sup>, Shawn E. Holt<sup>2</sup>, Keith O. Jenson<sup>2</sup>, <sup>1</sup>Department of Biology, Va. Commonwealth Univ., <sup>2</sup>Department of Pathology, Medical College of Va., Va. Commonwealth Univ. The extension of telomeres by telomerase causes cell lines to bypass senescence and allows the cells to proliferate indefinitely. The prostate cancer cell line P69 was used with two variations of the parental P69 and P69 itself. The two variations where P69 hTERT, which has been infected with the catalytic subunit of telomerase hTERT, and P69 pBABE, which is the control for the hTERT infected P69 with only the retroviral vector pBABE puro inserted. The cells were allowed to grow until approximately 60-80% confluent in modified RPMI media. The three cell types were then transfected with three different vectors, a positive control using the sv40 promoter enhancer and a luciferase gene, a negative control with nothing but the vector and the same vector with only the promoter region of hTERT. After transfection the cells were allowed to grow for three days and then the cells were passively lysed and a luciferase assay was performed. The results showed an increase of approximately two-fold promoter region activity in the P69 hTERT infected cells over the P69 parental and P69 pBABE. This could indicate that the transcription factor for hTERT is up regulated with the addition of more hTERT.

CDNA MICROARRAY ANALYSIS IN HYPO- AND HYPERCALCEMIA MODELS OF RENAL GENE REGULATION AND ASSOCIATION WITH DISEASE AND AGING. Amandeep Bajwa, M. J. Beckman, Department of Biochemistry, VCU, Richmond, VA 23298. The active form of vitamin D-1,25 dihydroxyvitamin D<sub>3</sub> (1,25-(OH)<sub>2</sub>D<sub>3</sub>) is converted from 25-hydroxyvitamin D<sub>3</sub> mainly in the kidney proximal tubules by the enzyme 1 $\alpha$ -hydroxylase (1 $\alpha$ -OHase). The synthesis of 1,25-(OH)<sub>2</sub>D<sub>3</sub> is regulated by dietary Ca<sup>2+</sup>, by Parathyroid Hormone (PTH) to increase 1 $\alpha$ -OHase, and by 1,25-(OH)<sub>2</sub>D<sub>3</sub> which regulates its own synthesis through a 1,25 dihydroxyvitamin D<sub>3</sub>-receptor (VDR)-dependent negative feedback effect on both 1 $\alpha$ -OHase and PTH. Rats were fed diets containing 0.02% calcium (-Ca<sup>2+</sup>) or 0.47% calcium (+Ca<sup>2+</sup>). Some of the -Ca<sup>2+</sup> and +Ca<sup>2+</sup> rats were given daily oral doses of different levels of vitamin D<sub>3</sub>, 0 (-D), or 4 $\mu$ g D<sub>3</sub>/day, (+D), also the +Ca,+D group was treated with 1,25-(OH)<sub>2</sub>D<sub>3</sub>. Using oligonucleotide microarray analysis, we screened hypo- and hypercalcemic sets of RNA to further study factors that down-regulate VDR and thereby may prove important as therapeutic targets of aging or disease. Ca<sup>2+</sup> and PTH receptors were both increased in hypo- compared to hypercalcemia. In addition, numerous gene expression products not previously linked to VDR regulation were screened and identified in both RNA sets.

RELATIONSHIP BETWEEN P53 AND P21 IN ME180 CELLS. Tracy Brandt & Rosemary Barra, Dept. of Biol. Sci., Mary Washington College, Fredericksburg, VA 22401. Human papillomavirus-infected cervical carcinoma cells express the E6 oncoprotein that binds to wild-type cell cycle control-protein TP53 (p53). This binding targets TP53 for early degradation and this action is linked to the development of the neoplasia. However, some of the cellular TP53 does not come in contact with oncoproteins and remains intact for its normal lifespan. ME-180 cervical carcinoma cells were treated with Calbiochem p53 Activator Fusion Peptide 46. This cell-permeable protein represents the activated ssDNA-binding end of TP53 and it releases the sequence-specific DNA binding activity of the TP53 core from its negative control. As a result, this treatment induced the ME-180 cells to develop senescent, and possibly apoptotic, characteristics. Cells also underwent TP53-dependent apoptosis when exposed to etoposide, confirming that this pathway is intact. The induction of senescence and apoptosis was observed using light microscopy, TUNEL assays, and a  $\beta$ -galactosidase assay. Therefore, it may be concluded that activation of the remaining TP53 is sufficient to induce senescence or apoptosis and should be investigated further as part of a potential treatment for this type of cancer.

NICOTINE AND HYPOXIA INDUCED APOPTOSIS IN H9c2 CARDIOMYOBLASTS. Daryl W. Williams & Rosemary Barra, Dept. of Biol. Sci., Mary Washington College, Fredericksburg, VA 22401. Apoptosis is an energy-dependent, programmed form of cellular death that can be triggered by a variety of intrinsic and extrinsic factors. Although cells contain a number of apoptotic signaling pathways, these pathways converge on a final common death sequence that is activated by a family of cysteine proteases, *caspases*. Occurrence of apoptosis and the behavior of BCL-2 and caspase-8 were examined in H9c2 cardiomyoblasts in response to exposure to nicotine and hypoxia. Cells exposed to hypoxia for 6 hours followed by reoxygenation for 2, 4 and 6 hours demonstrated 125%, 7.4% and 28.6% increases respectively in caspase-8 activity. Cells exposed to 0.5 mg/ml nicotine for identical periods of time also showed increases in caspase-8 activity, 3.2%, 5.1% and 42.8% respectively. These cells demonstrated DNA laddering on agarose gels and floating cells in cultures treated with 0.5 mg/ml nicotine for two hours demonstrated nuclear condensation as detected via propidium iodide staining and fluorescent microscopy. Adherent cells in these cultures showed a 343% increase in caspase-8 activity. These data suggest that H9c2 cardiomyoblasts undergo apoptosis via a caspase 8 dependent pathway when exposed to nicotine or hypoxia followed by reoxygenation.

MITOCHONDRIAL DYSFUNCTION IN NEURODEGENERATION: APOPTOSIS, CYTOSKELETAL DISRUPTION AND TRANSPORT ABNORMALITY. Kathleen J. S. Griffioen<sup>1</sup>, Othman Ghribi<sup>2</sup>, Nena Fox<sup>3</sup>, Michael S. Forbes<sup>2</sup>, Robert S. Brindle<sup>1</sup>, John Savory<sup>2</sup>, & David A. DeWitt<sup>1</sup>. <sup>1</sup>Dept. Biology and Chemistry, Liberty University, Lynchburg, VA 24502, Dept. Pathology and Dept. Microbiology, University of Virginia, Charlottesville, VA. Previously, we developed an *in vitro* model of neurodegeneration utilizing aluminum maltolate (Al) to trigger the death of human neuroblastoma cells (NT2). Electron microscopy was used to verify nuclear fragmentation consistent with an apoptotic morphology. Al treated cells were TUNEL positive and confocal microscopy demonstrated cytochrome c release in some cells. Surprisingly, mitochondria clustered in the peri-nuclear region suggesting a disruption of intracellular transport. In addition,  $\beta$ -tubulin immunocytochemistry demonstrated an accumulation of this protein also in the peri-nuclear region. In differentiated cells, long neuronal processes lacked neurofilament protein and had few mitochondria. We also observed swollen regions in these processes with clumps of mitochondria and cytoskeletal proteins. Taken together, these results suggest apoptosis and cytoskeletal changes may be linked. Supported by the Jeffress Memorial Trust J-572, and the Virginia Academy of Science (KJSG).

INHIBITION OF LIPOPOLYSACCHARIDE-INDUCED PREGNANCY LOSS IN CD-1 MICE BY TREATMENT WITH HEPARIN AND ASPIRIN. Alison M. Warren<sup>1</sup>, Carolyn M. Conway<sup>2</sup>, and Arthur F. Conway<sup>1</sup>. <sup>1</sup>Dept. of Biol., Randolph-Macon Coll., and <sup>2</sup>Dept. of Biol., Virginia Commonwealth Univ. Lipopolysaccharide (LPS) from the outer cell wall of Gram-negative bacteria causes pregnancy loss in mice. Ten mice received low dose heparin (3.8 units/day) injected subcutaneously (s.c.) plus aspirin (31  $\mu$ g/day in 0.095% ethanol as drinking water), 10 mice received higher dose heparin (7.6 units/day s.c.) plus aspirin (62  $\mu$ g/day in 0.095% ethanol as drinking water), and 10 control mice received PBS injections (s.c.) and drinking water with 0.095% ethanol on days 8-11 of gestation. On day 9, 5 mice from each group received LPS (5 $\mu$ g in 0.05 ml PBS i.v.) and the other 5 mice from each group were injected with PBS. All mice were sacrificed on day 12. The frequency of pregnancy loss was significantly increased by LPS treatment. The lower dose of heparin and aspirin reduced the frequency of pregnancy loss in 3 of the 5 LPS-injected females, but the difference was not statistically significant. The higher dose of heparin and aspirin had no effect on LPS-induced pregnancy loss. These results suggest that heparin and aspirin may be able to inhibit LPS-induced pregnancy loss in mice, but were not consistently effective at the doses used in this study.

GENE TRANSFER IN *Porphyromonas gingivalis*. Jovonni R. Spinner & Kevin Jones, Dept. of Biology & Philips Institute, Oral Molecular Biology, Virginia Commonwealth University, Richmond, VA 23284. *Porphyromonas gingivalis* is an anaerobe that is a member of the black-pigmented group Bacteroides. It is the major contributing factor in periodontal disease. Currently, a gene reporting system does not exist for *P. gingivalis*. Two different mutant strains of *P. gingivalis*, FLL 100 (tetracycline resistant) and W83 (erythromycin resistant), were mated via conjugation with each other or with *Bacteroides fragilis* (rifamycin resistant) to determine if gene transfer was possible between the different strains. Several matings were set up using different ratios because it was not known which strain would be the donor or recipient. Based on the results, it was concluded that gene transfer did not occur. In addition, strains of *Porphyromonas asaccharolytica* (2256 and 1912) and *P. gingivalis* (YH and F2) were screened for plasmid DNA using the Qiagen mini prep kit and large scale Cesium preps. Based on the results from the gels, plasmids were detected in *P. asaccharolytica* but no plasmids were detected in *P. gingivalis*.

THE ISOLATION AND STUDY OF HALOPHILIC ARCHAEA FROM THE SALARS OF THE ATACAMA DESERT IN CHILE. J. Harris Carpenter & Carol D. Litchfield, Dept. of Biol., George Mason University, Fairfax, VA 22030. The Atacama Desert of Chile can be considered a hyper-arid and extreme environment. Salars of the desert have been found to contain halophilic microorganisms. Using PCR and amplicon length heterogeneity (ALH) fingerprinting, a salt sample from the desert

was found to contain various strains of halophilic Archaea. The isolated cultures were determined to grow most efficiently on Modified Casamino Acid medium with Tap water (MCAT) containing 15% solar salt and incubated at 37°C. Different sources of carbon and amino acids than those normally used in MCAT were explored. Organisms that grew on these new variations were not transferable back to standard MCAT. None of these organisms would grow in standard selective media. Future methods for identification of the isolated cultures include inoculation of API NE 20 selective media strips, BIOLOG metabolic tests, and 16S rRNA sequencing.

BOTTLENOSE DOLPHIN UTILIZATION OF THE ELIZABETH RIVER, VIRGINIA. Kevin M. Foss & James R. Reed, Dept. of Biology, Chemistry and Environmental Science, Christopher Newport University, Newport News, VA 23606. As the Elizabeth River is both toxin laden and extensively used by commercial, military and pleasure craft, it presents a unique and previously unstudied habitat for Bottlenose dolphins (*Tursiops truncatus*). Using standard protocols for dolphin research, 43 cruises were made over the course of three years and data was recorded on behavior, location and number and animals were recorded on film. The most common behavior observed was feeding. An annual pattern of usage of the river began in May, with a peak in August and no activity from November to April. A diurnal pattern of movement appeared to be used, with no effects seen due to tidal state or weather. Spatially, the dolphins used the main branch of the river most frequently, but with common use of the Lafayette River, a tributary. Using the photo ID data, 125 individuals have been identified using the Elizabeth River during the summer of 2000. A Caughley recapture estimate was used to derive a total population estimate of 216. Habituation to small boat traffic has been noted, as has reactions such as bunching and extended diving near larger vessels. A solitary dolphin overwintering for the past two winters and seen begging has been found dead from propeller strike.

A SURVEY OF THE BATS OF A. P. HILL, CAROLINE COUNTY, VIRGINIA. A. Scott Bellows<sup>1</sup> & Joseph C. Mitchell<sup>2</sup>, <sup>1</sup>Dept. of Biol. Sciences, Old Dominion University, Norfolk, VA 23529 & <sup>2</sup>Dept. of Biol., University of Richmond, Richmond, VA 23173. We monitored bat activity on Fort A.P. Hill, Caroline County, Virginia, using mist nets (72 nights) and ANABAT® systems (24 nights) during Apr-Oct 2000 and Apr-Aug 2001. A total of 40 sites were sampled that were classified into three forest (hardwoods [HW], mixed pines and hardwoods [MX], pines [PN]) and three habitat types (permanent waters [PW], riparian corridors [RC], uplands [UP]). We captured 407 bats in mist nets, representing eight species: *Lasiurus borealis* (n=281), *Eptesicus fuscus* (47), *Pipistrellus subflavus* (36), *Myotis septentrionalis* (13), *M. lucifugus* (12), *Lasionycteris noctivagans* (9), *L. cinereus* (3), and *Nycticeius humeralis* (5). There were no differences ( $F=0.64$ ,  $P=0.535$ ) in overall captures/100 net nights (NN) among forest types. Overall captures/100 net nights (NN) differed ( $F=3.31$ ,  $P=0.047$ ) among habitat types; post-hoc analyses could not tease out significantly different pairs. Captures/100NN for *L. borealis* were higher ( $F=3.93$ ,  $P=0.028$ ) for PW than for RC and UP. No other significant differences in captures of species among habitat types or forest types were revealed. The ANABAT® system detected a higher number of bat spp./night ( $t=1.17$ ,  $P<0.00001$ ) than mist nets.

MALE SONG REPERTOIRE SIZE AND FEMALE CHOICE IN THE GRAY CATBIRD. C. E. Clarkson, E. T. Haas, J. K. Miller, & A. S. Dolby, Department Biological Sciences, Mary Washington College, Fredericksburg, VA 22401. Sexual selection theory proposes that elaborate male secondary sexual characteristics have evolved in some species because they confer a mating advantage upon their bearers. Such characters may make males more attractive to females by reflecting their genetic quality and/or their ability to provide females with direct reproductive benefits. The Gray Catbird is sexually monomorphic in appearance. However, males sing elaborate songs during the breeding season while females sing little. We tested the hypothesis that female choice for large repertoire size is a selective pressure that has produced song sexual dimorphism in catbirds. We indexed song repertoire size by counting the number of unique phrase types produced by each male during a five-

minute sample of song recorded in separate one-minute bouts. We found no correlation between song repertoire size and either pairing date or any of the parameters of male physical condition that we measured. We did, however, find a suggestive relationship between repertoire size and male chick feeding rates relative to their mates'. This study was funded by the Jessie Ball DuPont Foundation Summer Research Program and Mary Washington College.

**BOTTLENOSE DOLPHIN INFANTICIDE IN VIRGINIA.** D.M. Boyd, S.G. Barco & W.M. Swingle, Virginia Marine Science Museum Stranding Program, Virginia Beach, VA 23451 Old Dominion Univ., Norfolk, VA 23529. Examination of stranded bottlenose dolphins (*Tursiops truncatus*) led to the discovery of infanticide in Virginia in 1997. For this study, we examined post 1997 *Tursiops* calves (<200cm) from Virginia for evidence of traumatic injuries associated with infanticide. Using <160cm total length as a crude definition of young of the year (YOY), we compared YOY stranding data from Virginia with YOY strandings in other mid-Atlantic states (NJ-NC). The number (n=49) and percent (36%) of stranded *Tursiops* YOY were significantly higher (1 Factor model I ANOVA; F=8.63, df 6 and 27, p<0.001) at the 36° of latitude (which includes all of Virginia beach) than all other latitudes examined (40°-33°). Ten traumatized YOY from 1998-2001 in Virginia were fresh or moderately decomposed and had multiple broken bones, soft tissue damage and bilateral injuries consistent with those examined in 1997, but had no significant gender difference as was observed in 1997. Eight of the ten traumatized YOY had fetal folds or lines and 70% had four or more neonatal characteristics. None of the traumatized YOY showed evidence of fishery interaction.

**REPRODUCTIVE CORRELATES OF AN ANAL GLAND IN THE HISPID COTTON RAT.** Robert K. Rose, Department of Biological Sciences, Old Dominion University, Norfolk, Virginia 23529-0266. During a study of the annual cycle of reproduction in the hispid cotton rat (*Sigmodon hispidus*) in southeastern Virginia, my students and I discovered an anal gland that is present only in males. The anal gland rings the lower end of the rectum and has ductal connections to the urethra, through which its secretions likely are delivered. This fatty gland is highly developed during the breeding season but, like the testes and accessory glands, regresses during the winter non-breeding season. The cyclicity of the anal gland, which is highly correlated with that of testes and of seminal vesicles, suggests that it somehow facilitates normal reproduction. The combined mass of testes, seminal vesicles, and anal gland constitutes only about 0.1 percent of an adult male's body mass during the winter months, but as much as 4 percent of body mass during the breeding season. Thus, males devote a large amount of energy to growing and maintaining these glands in anticipation of and during the breeding season. The function of the anal gland and the nature of its secretion are unknown.

**VASCULATURE OF THE PAROTOID GLANDS OF *Bufo terrestris* AND *B. valliceps*.** Deborah A. Hutchinson & Alan H. Savitzky, Dept. of Biol. Sci., Old Dominion University, Norfolk, VA 23529. The parotoid glands of toads are large aggregations of granular glands located above the shoulders. To determine the vascular pattern of these glands in *Bufo terrestris* and *B. valliceps*, we perfused the vascular system of specimens with either India ink or Microfil, a fine latex. The perfused glands were then examined by gross dissections, microscopic examinations, and histology. The parotoid glands of both species are supplied with blood by the dorsal ramus of the cutaneous artery and drained by a branch of the internal jugular vein. This pattern of blood flow has not been described previously for the parotoid glands and conflicts with prior accounts for other congeners. The internal jugular vein of *B. terrestris* and *B. valliceps* receives both the vertebral vein and a branch from the parotoid gland. The artery that supplies the parotoid gland and the vein that drains it ramify into capillaries that surround the individual lobules of the gland. Extensive vasculature presumably is important for delivering cholesterol and other molecules that are precursors to the toxins synthesized in the parotoid glands.

A COMPARATIVE STUDY OF DERMAL MORPHOLOGY IN BOID SNAKES. Troy Shell<sup>1</sup>, Victor R. Townsend, Jr.<sup>1</sup> & Alan H. Savitzky<sup>2</sup>. <sup>1</sup>Virginia Wesleyan College, 1584 Wesleyan Drive, Norfolk/Virginia Beach, VA 23502 and <sup>2</sup>Department of Biological Sciences, Old Dominion University, Norfolk, VA 23529. Despite the functional significance of the skin of snakes for both feeding and locomotion, relatively few studies have investigated the relationship between adaptation to particular habitats and the structure of skin. In addition, prior studies of skin structure have focused almost entirely upon the epidermis. We examined the dermis of snakes of both subfamilies of Boidae, Boinae and Erycinae. Our sample included arboreal taxa (*Corallus*), fossorial taxa (*Calabaria*, *Eryx*), and species of terrestrial or generalized habits (*Boa*, *Candoia*). For each taxon, samples of skin were removed from anterior, middle, and posterior regions of the body. Skin samples were embedded in paraffin and sectioned with a rotary microtome. Serial transverse and oblique sections were stained with either iron gallein or a trichrome stain to reveal the distribution of elastin or collagen fibers, respectively. Our results indicate that the dermis of boas differs markedly from the condition observed in a more derived group, the colubroids. In addition, we observed intergeneric variation in the density and distribution of elastin fibers.

A COMPARATIVE STUDY OF THE INTEGUMENT OF COLUBRID AND VIPERID SNAKES. Victor R. Townsend, Jr.<sup>1</sup> & Alan H. Savitzky<sup>2</sup>. <sup>1</sup>Virginia Wesleyan College, 1584 Wesleyan Drive, Norfolk/Virginia Beach, VA 23502 and <sup>2</sup> Department of Biological Sciences, Old Dominion University, Norfolk, VA 23529. Relatively little is known about the morphology of the dermis for most species of reptiles. In particular, the structural and mechanical properties of the skin of snakes remain largely unexamined. In this study, we investigated the distribution of elastin and collagen fibers in the dermis of representative species of colubroid snakes. We examined the skin of five species of Colubridae (*Coluber constrictor*, *Dasyeltis scabra*, *Elaphe obsoleta*, *Nerodia fasciata*, *Ophedryx aestivus*), six species of Viperidae (*Agkistrodon contortrix*, *A. piscivorous*, *Atropoides nummifer*, *Calloselasma rhodostoma*, *Crotalus atrox*, *C. horridus*), and one species of Atractaspididae (*Atractaspis bibronii*). For each taxon, serial transverse sections were stained with either iron gallein or a trichrome stain to reveal the organization of elastin or collagen fibers, respectively. Our results indicate that the elastin fibers are largely confined to the stratum compactum, the deeper layer of the dermis. The overlying stratum laxum consists mainly of loosely organized collagen fibers. Considerable interspecific variation in dermal morphology and skin folding of intersquamous skin was observed.

SPECIFICITY OF ORGANIC ANION TRANSPORT IN MALPIGHIAN TUBULES OF THE CRICKET, *ACHETA DOMESTICUS*. R. Kauffman, N. Burkholder, A. Jenner, and D. Graber Neufeld, Dept. of Biology, Eastern Mennonite University. The dye fluorescein (FL) is a substrate of the organic anion transporter (OAT) in mammals. Using epifluorescence microscopy, we characterized the specificity of FL transport in crickets. The OAT inhibitors *p*-aminohippuric acid (PAH, 3 mM) and glutarate (250  $\mu$ M) caused no significant inhibition of FL uptake. As in mammals, a monocarboxylic acid series (3 mM) showed increasing affinity with increased carbon chain length. Two substances totally blocked FL accumulation: probenecid (1.0 mM), an OAT inhibitor, and verapamil (0.1 mM), a substrate of P-glycoprotein. The insecticide chlorpyrifos and its oxon did not cause significant inhibition of FL uptake at 0.5 mM concentrations. The phenoxy herbicide 2,4-D did inhibit FL uptake by 50%. Nicotine, a plant alkaloid, did not inhibit FL accumulation. Our tests demonstrate the presence of a vigorous, multispecific transport system for organic substrates in the Malpighian tubules of crickets. The fluorescein transporter in crickets does have OAT-like characteristics, including monocarboxylic acid affinity and probenecid uptake, however the transporter also displays several novel characteristics such as verapamil transport and low PAH and glutarate affinities.

COMPUTER-ASSISTED ANALYSIS OF COTTON STAINER INSECT VARIATION: PRELIMINARY RESULTS. Harold J. Grau, Dept. of Biol., Chem., & Env. Sci., Christopher Newport Univ., Newport News, VA 23606. Cotton stainers (*Dysdercus* sp.) are pan-tropical hemipterous insects that feed primarily on Malvaceous plants. Several distinct populations of *D. andreae* are found on St. Thomas, USVI. Data previously collected by hand in the field suggested that there may be significant morphological variation among these populations, possibly as a result of geographic isolation. More recently, we have been building a collection of digital images of these insects so that analyses of body size parameters and wing spot patterns could be computerized, using the NIH Image application. Preliminary results indicate that significant differences in body size parameters among populations from various locations do exist.

NOCTURNAL THERMOREGULATION IN THE WHITE-THROATED SPARROW. K. M. Stechler, V.S. Davis, A.S. Dolby, & J.G. Temple. Department of Biological Sciences, Mary Washington College, Fredericksburg, VA 22401. Nocturnal hypothermia has been observed in a number of bird families. However, possible use of this energy-saving strategy by members of family Emberizidae has been little investigated. We used temperature sensitive radio-transmitters to determine whether White-throated Sparrows employ nocturnal hypothermia during winter. We obtained skin temperature measurements on 13 free-ranging sparrows for three consecutive days and nights per subject. The majority of sparrows reduced their body temperatures by 2-3 degrees C, which is not reduction enough to confidently suggest use of hypothermia. A 2-degree drop in body temperature is simply sleep-related in most species. However, three subjects reduced their body temperatures by an average of 5 degrees or more. The maximum reduction recorded for all subjects was 8.5 degrees. Thus, White-throated Sparrows exhibit variability with regard to nocturnal hypothermia use. Preliminary results show no correlation between depth of body temperature reduction and 1) ambient temperature, 2) body mass, and 3) body fat index. We are continuing to investigate the source of this variation. This project was funded by an Undergraduate Research Grant from Mary Washington College.

A COMPARISON OF THE DEFENSIVE BEHAVIORS OF RATSNAKES AND WATERSNAKES. Ryan Killarney & John Temple, Dept. of Biol. Sciences, Mary Washington College, Fredericksburg, VA 22401. Snakes display a variety of defensive behaviors ranging from striking to coiling and death-feigning. We studied the defensive behaviors of juvenile banded watersnakes (*Nerodia fasciata*) and black/yellow ratsnakes (*Elaphe obsoleta*). Snakes were placed in a testing arena, given simulated predatory attacks at five different body regions and the behavioral responses were recorded. Both species consistently displayed the aggressive behaviors of gaping, striking or biting and no species-specific differences were found. Thrashing behavior was consistently displayed by watersnakes in response to stimuli at all body regions and was statistically more prevalent in watersnakes than in ratsnakes for four of the five body regions ( $p < 0.05$ ). Coiling behavior in ratsnakes was suggestively more prevalent than in watersnakes when stimulated at the posterior body regions ( $p = 0.056$ ). These results suggest that aggressive behaviors are important defense mechanisms for both species. Thrashing behavior may be an important escape mechanism for watersnakes, possibly due to their semi-aquatic habitat. This project was funded by an Undergraduate Research Grant from Mary Washington College.

A NOVEL APPROACH IN CLONING, OVER-EXPRESSING AND PURIFYING *E. COLI*'S TRNA GENE AND ITS PRODUCT, TRNA<sup>m</sup>U54 METHYLTRANSFERASE (RUMT). LaToya Griffin & Cecile Andraos-Selim, Dept. of Biological Sciences, Hampton University, Hampton, VA 23668. More accurate and less laborious techniques are needed for cloning, expressing and purifying bacterial tRNA modification enzymes. There are fifty genes in *E. coli* that are responsible for tRNA modification, one of which is the *trmA* gene that codes for the enzyme, tRNA<sup>m</sup>U54 methyltransferase (RUMT). This enzyme catalyzes the methylation of uracil at position 54 of the tRNAs' T<sub>Ψ</sub>C loop. RUMT increases the fidelity of protein synthesis, influences the rate of protein



synthesis and stabilizes the three dimensional structure of tRNA. Our goal is to produce ample amount of purified *E.coli* RUMT using reproducible, simple and fast techniques. In this research project we have demonstrated that *trmA*, with appropriate primers, is properly amplified using the Polymerase Chain Reaction (PCR). We demonstrated that the amplified PCR product is cloned into a pET expression vector by way of TOPO cloning and purified using immobilized metal affinity chromatography. Future implementations of these techniques will lead to further structural, mechanical and biophysical investigations of significant amounts of highly purified RUMT and other tRNA modification enzymes.

AN INITIAL ATTEMPT AT DELETING THE *ANX 14* GENE FROM *NEUROSPORA CRASSA*. Carl E. Creutz<sup>1</sup>, Kevin Cartwright<sup>2</sup>, Neil Adesso<sup>2</sup> & Philip Rock<sup>2</sup>, <sup>1</sup>Dept. of Pharmacology, Univ. of Virginia, Charlottesville, VA 22908, <sup>2</sup>Virginia Wesleyan College, Norfolk, VA 23502. We attempted to delete the annexin-encoding *anx 14* gene from *Neurospora crassa*. The annexin gene and flanking genomic DNA sequences were subcloned from a cosmid obtained from the *Neurospora* Genome Project. We generated an annexin knock-out plasmid by replacing the coding region of the annexin gene with a gene for resistance to the antibiotic hygromycin B. Electroporation of the knock-out plasmid into wild-type, hygromycin-sensitive conidiospores generated fifty hygromycin-resistant transformants. PCR analysis of hygromycin-resistant progeny derived from the first twenty transformants indicated that these transformants resulted from ectopic incorporation of the knock-out plasmid into the genome. While most of these ectopic transformants have been phenotypically normal, one class displays a temperature-sensitive hygromycin-resistance. Growth of such transformants is normal in the absence of hygromycin and inhibited by hygromycin below 30 °C. Above 30 °C, exposure to hygromycin is lethal. Such transformants cannot act as the male gamete in a sexual cross but can act as the female gamete. We have yet to obtain a transformant that lacks the annexin gene.

AN EXAMINATION OF MICROORGANISMS AND THEIR ANTIBIOTIC RESISTANCE PATTERNS IN RURAL, URBAN, AND TIDAL WATER SAMPLES. Paula B. Lessem, C. Elkins, & K. Hackett, Dept. of Biology, Univ. of Richmond, Richmond, Va. 23173. Water samples from rural (9), urban (3), and tidal (8) sources in eastern Virginia were obtained. Fecal coliforms were isolated using the Coliscan Easygel system and were then screened via minimum inhibitory concentrations (MICs) for resistance to six common antibiotics including erythromycin. Finally, *Escherichia coli* B and *Staphylococcus aureus* ATCC 9144 were grown in membrane-filtered water from the same sites for an approximate period of ten day after which the MICs for the same six antibiotics were repeated. Erythromycin resistance was induced in the *S. aureus* strain following incubation in a filter-sterilized tidal and tap water samples. The MIC for erythromycin in *S. aureus* pre-induction was 0.5 µg/ml. Following induction, the MIC increased to 500 µg/ml (tidal) and 125 µg/ml (tap water). The induced resistance in these water samples indicates that one of four different types of erythromycin resistance genes was turned on by something inherent in the water. RNA from these strains has been isolated and future studies using RT-PCR techniques could potentially determine which genes, if any, were turned on in these strains. Supported by the Undergraduate Research Committee, Univ. of Richmond.

PRELIMINARY CHARACTERIZATION OF *SPY1600*, A PUTATIVE HYALURONIDASE GENE IN *STREPTOCOCCUS PYOGENES*. Karin M. Berling and Wayne Hynes, Dept. of Biol., Old Dominion Univ., Norfolk, VA 23529. *Streptococcus pyogenes* produces many different virulence factors, and the recently completed sequences of two streptococcal genomes (strains SF370 and MGAS8232) have established the existence of several previously unknown genes encoding possible virulence factors. Among these is *Spy1600*, which based on its nucleotide similarity to other hyaluronidase genes, has been proposed to encode a version of this enzyme. The gene has, however, no homology to the hyaluronidase genes in various *Streptococcus* species. The aim of this project is to determine whether *Spy1600* is a hyaluronidase. Primers were designed from a published

sequence, and the gene amplified by PCR. The gene was detected in all 50 strains tested, which indicates a conserved genetic region in the genome. According to the sequence there is no signal peptide within the first forty amino acids of the N-terminal, which would suggest an intracellular product or a non-typical secretion mechanism. The *Spy1600* genes from different strains have been cloned, transformed into *E. coli*, and tested for hyaluronidase activity using a standard hyaluronidase assay. So far, none of the cloned genes have shown activity either intra- or extracellularly. *Spy1600* from strain 10403 has also been sequenced and shows 97% and 98% homology to the genes of SF370 and MGAS8232 respectively.

### Biomedical and General Engineering

BRAIN REORGANIZATION AND TINNITUS. Martin Lenhardt, Depts. of Biomedical Engineering and Otolaryngology, Virginia Commonwealth University, Richmond, VA. Adult mammalian brains are not hard wired for life but are very plastic especially in the sensory and motor areas. Recently, brain reorganization has been reported in imaging studies of patients with tinnitus, that is, patients experiencing phantom sound perception. Although tinnitus is often associated with hearing loss it isn't necessary for tinnitus to develop. In fact somatomotor maneuvers can induce or alter tinnitus. A novel treatment approach has been developed based on a central neural site of tinnitus generation due to brain reorganization as a result of auditory and cross modality interactions. The treatment involves delivery of high frequency patterned stimulation aimed at the reversal of brain reorganization hypothesized as essential for tinnitus generation. Cross modality stimulation was also employed. In a pilot study eight out of nine patients experienced tinnitus suppression immediately after treatment and for most this residual inhibition lasted for days and in a few cases weeks. A demonstration will be provided using a unique piezoelectric actuator that is placed on the skull for bone conduction stimulation.

INFANT ECHOLOCATOR. Douglas G. Richards & Martin Lenhardt, Dept. of Biomedical Engineering, Virginia Commonwealth University, Richmond, VA. This project is developing an innovative echolocation device to serve a large population of blind infants who at present have few alternatives to enhance their sensory capabilities and facilitate motor development. The device under development: (a) is the only sensory substitution device for the blind to make use of the human ability to perceive bone conducted high audio (10-20 kHz) and ultrasound (20 - 100 khz); (b) makes use of the natural capacity for echolocation, rather than relying on processed sound, potentially facilitating the learning process, and making a more natural sensory substitution; and (c) by presenting the sounds in the high audio and ultrasonic regions through bone conduction, it does not interfere with hearing of speech or environmental sounds. Feasibility is being demonstrated by a performance evaluation of the sonar parameters relevant to use by a blind infant, e.g. field of view, size and distance of object detection, and of the output to existing data on bone conduction thresholds and frequency discrimination. Alternative modes of coding distance and direction are being explored, including amplitude modulation, frequency modulation, and pulse modulation of high audio and ultrasonic carriers.

MULTIMODAL INFANT HEARING AID. Brandon May, Douglas G. Richards, Alan G. Madsen, & Martin L. Lenhardt, Dept. of Biomedical Engineering, Virginia Commonwealth University, Richmond, VA. This project is developing an innovative, vibrotactile/bone conduction aid for hearing impaired infants. The aid is innovative in that it: (a) employs two simultaneous modalities for hearing remediation: vibrotactile and bone conduction, (b) presents both components on the head, an area of the body relevant to speech communication, (c) does not interfere with air conduction hearing, and (d) employs a visual indicator of speech sound level to facilitate linguistic interactions. The project is assessing hardware (e.g., transducers, processors, and amplifiers), developing a speech processing algorithm, and integrating them into a prototype hearing aid. The algorithm separates features of speech (e.g., the fundamental and formants) into appropriate bands for the different transducers. The

long-term objective is to develop a commercial, wearable aid, which will serve a large population of hearing impaired infants who at present have few alternatives for hearing remediation.

PERFORMANCE EVALUATION OF A PACKED-BED BIOREACTOR WITH DOWNSTREAM AMPEROMETRIC DETECTION USING INTERDIGITATED MICROSENSOR ELECTRODE ARRAYS AND GLASSY CARBON ELECTRODES. Kennard M. Brunson, Sean Brahim, & Anthony Guiseppi-Elie, Center for Bioelectronics, Biosensors and Biochips (C3B), Virginia Commonwealth University, Richmond, VA 23284-3038. Flow Injection Analysis (FIA) is a rapidly growing analytical technique that is quickly replacing conventional "beaker chemistry". In this project we evaluated the performance of the amperometric detector of the flow system. Four characteristics of the amperometric response using glassy carbon electrodes were investigated: the peak height, peak area, peak width at  $\frac{1}{2}$  max., and the lagtime between sample injection and signal. The initial analyte chosen was potassium ferrocyanide ranging in concentrations from 0.001M to 0.01M. The data showed a correlation between average peak height and average peak area, with values ranging from 1.0 to 4.5 A and 0.9 to 5.6 A\*min respectively. Lag times ranged between 1.5-2.0 min with an average lag time of 1.7 min while peak widths held steady at ca. 2 min. The second analyte tested was hydrogen peroxide at concentrations from  $2 \times 10^{-7}$ - $10^{-6}$ M. The data also showed a correlation between height and area with values ranging from 1.34-1.54 nA and 5.3-7.6 nA\*min respectively. Lagtime ranged between 1.75-2.05 min an averaged 1.92 min. Widths averaged 1.08 min.

BIO-SMART HYDROGELS: CO-JOINED MOLECULAR RECOGNITION AND SIGNAL TRANSDUCTION IN BIOSENSOR FABRICATION AND DRUG DELIVERY. Sean Brahim & Anthony Guiseppi-Elie, Center for Bioelectronics, Biosensors and Biochips (C3B), Virginia Commonwealth University, Richmond, VA 23284-3038. Two groups of materials that have received widespread attention are hydrogels and conducting electroactive polymers. We have integrated these two materials and physically entrapped enzymes within their matrices to produce novel chemically responsive polymers, which we call electroactive hydrogels. The enhanced biosensing capabilities of these composite films have been demonstrated in the fabrication of glucose, cholesterol and galactose biosensors. All biosensors displayed extended linear response ranges ( $10^{-5}$  -  $10^{-2}$  M), rapid response times (< 60 s), retained storage stabilities of up to 1 year, and exhibited excellent screening of the interferents ascorbic acid, uric acid, acetaminophen and L-cysteine. The cross-linked hydrogel component of these composite films was also prepared with an amine containing methacrylate monomer and entrapped glucose oxidase to produce glucose-response, pH-sensitive polymeric devices. When insulin was subsequently loaded into these "bio-smart" devices, there was a significant increase in insulin release rate when the devices were immersed in glucose solutions.

NEW APPROACH FOR MOLECULAR IMPRINTING. Dmitry Pestov, Natalia Levit, & Gary C. Tepper, Dept. of Chemical Engineering Virginia Commonwealth University, Richmond, VA 23284. We describe a new molecular imprinting technique applied to small particles of monomers with solid-state reactivity. Heptane was used as the print molecule and a Surface Acoustic Wave (SAW) mass sensor was used to detect vapor uptake in the particles. In our imprinting process, the nanoparticles of the monomer (2,5-distyryl-pyrazine or p-phenylenediacrylic acid diethyl ester) were produced by fast expansion of supercritical solution and deposited directly onto the surface of the SAW device. Then, the particles were polymerized at room temperature in the presence of saturated template vapor by UV irradiation. The template molecule was extracted from the particles and molecular imprinting effect was evaluated. Acknowledgements. This material is based upon work supported by the National Science Foundation under grant number 0097409.

SAW BASED CHEMICAL SENSORS: SIGNAL EVALUATION. Bridget Deveney, Gary Tepper, Dmitry Pestov, & Natalia Levit, Dept. of Chemical Engineering, Virginia Commonwealth University, Richmond, VA 23284. Surface Acoustic Wave (SAW) based chemical sensors are extremely sensitive miniature portable chemical sensors. Polymer coatings can be used to make these sensors selective for various chemical vapors. The nature of polymer films makes the signal for these sensors complex and difficult to analyze. Several methods of signal evaluation are compared and their application to differing polymer coatings and solvents are discussed.

INFRARED PARASPINAL TEMPERATURE MEASUREMENT AND HEALTH STATUS. Douglas G. Richards<sup>1,2</sup>, David L. McMillin<sup>2</sup>, Eric A. Mein<sup>2</sup>, & Carl D. Nelson<sup>2, 1</sup>Dept. of Biomedical Engineering, Virginia Commonwealth University, Richmond, VA and <sup>2</sup>Meridian Institute, Virginia Beach, VA. The purpose of this study was to explore correlations between an objective measurement related to chiropractic and osteopathy - paraspinal temperature variation - and health quality of life. Paraspinal temperature variation has claims for clinical relevance going back to the early days of chiropractic, but there has not previously been any objective confirmation. Temperature imbalances along the spine have been seen as indicators of both somatic and visceral dysfunction, although in the past this has been difficult to quantify. This exploratory study compared paraspinal temperature measurements using the Tytron C-3000 (a computer-interfaced device with paired, infrared sensors) with questionnaire measurements using the SF-36 short form health survey, a well-validated measure of health status. Data from 79 people participating in health assessments were used. The correlations of the SF-36 with measurements of temperature differential on either side of the spine, and temperature variations along the spine, ranged from  $r = -.23$  to  $-.28$ , and were statistically significant at the .05 level. Thus temperature imbalances in the spine are correlated with lower health quality of life.

INFLUENCE OF GEOMETRY OF REPAIRED ARTICULAR CARTILAGE DEFECTS ON CREEP BEHAVIOR DURING INDENTATION. Corrie E. Spoon & Jennifer S. Wayne Orthopaedic Research Laboratory, Depts. of Biomedical Engineering and Orthopaedic Surgery, Virginia Commonwealth University, Richmond, VA 23298. The mechanical properties of articular cartilage are commonly determined using the indentation test. Geometric parameters such as the specimen thickness and indenter radius can vary greatly between indentation applications. This investigation determined whether the geometric parameter variations and degree of integration between the repair and normal cartilage effect the behavior of osteochondral defects and consequently the mechanical properties determined through creep indentation. ABAQUS® finite element analysis simulated the indentation of osteochondral defects with varying ratios of indenter radius to cartilage height ( $a/h=0.5, 1.5$ ) and cartilage radius to indenter radius ( $r/a=2, 5$ ). Fully integrated and non integrated defects were modeled. The vertical displacement under the indenter was curve fit to the biphasic theory to determine the aggregate modulus, permeability, and Poisson's ratio. For specimens with an  $a/h$  of 1.5, changes to the specimen radius ( $r/a$ ) and degree of integration between repair and normal cartilage did not affect the indentation behavior or the mechanical properties determined. Specimens with an  $a/h$  of 0.5, demonstrated a dependence on specimen radius and degree of integration.

NEW TESTING METHOD FOR ASSESSING THE MECHANICAL BEHAVIOR OF ARTICULAR CARTILAGE. Michael J. Araj & Jennifer S. Wayne, Orthopaedic Research Laboratory, Depts. of Biomedical Engineering and Orthopaedic Surgery, Virginia Commonwealth University, Richmond, VA 23298. Mechanical properties of cartilage are required to assess the tissue's ability to function in a joint. Many experimental testing methodologies exist, but few are nondestructive nor suited for in vivo measurements. This study began the development a new nondestructive test to determine cartilage properties that will have application in vivo through arthroscopy. It employed a laser reflectance system to measure cartilage deflection under the action of an aspiration pressure. Experimental measures found deflection of cartilage from a porcine tibial

surface to be ~80microns under an aspiration pressure of 0.1MPa. The experimental configuration was also simulated with a finite element model to predict mechanical behavior. Finite element deflection of the tissue under the same conditions was less than found experimentally. Further improvement of the finite element model will include altering input parameters, boundary conditions, and material symmetry. A combination of experimental testing and theoretical modeling will create a method not currently available to measure cartilage properties in vivo.

A TECHNIQUE FOR MEASURING FIBULA MOTION RELATIVE TO THE TIBIA DURING TORSIONAL EXPERIMENTS. John R. Owen<sup>1</sup>, Timothy J. Marquee<sup>1</sup>, Jennifer S. Wayne<sup>1,2</sup>, & James B. Carr<sup>1</sup>, Orthopaedic Research Laboratory, Depts. of <sup>1</sup>Orthopaedic Surgery and <sup>2</sup>Biomedical Engineering, Virginia Commonwealth University, Richmond, VA 23298. One type of ankle injury results in the tibia and fibula separating (tibiofibular diastasis) causing the ankle to become unstable. Biomechanical evaluations of repair methods should include measurement of tibiofibular diastasis in terms of medial/lateral and posterior/anterior translation, as well as internal/external rotation of the fibula relative to the tibia. Previous studies have not adequately addressed diastasis measurement. Therefore, a device has been developed to measure all three components. A bracket is attached to the fibula and is free to move with it relative to the tibia. A unique arrangement of uni-directional sensors join the fibula bracket to a reference frame that is rigidly attached to the tibia. Instead of directly measuring the three components, the sensors form a combination of triangles that change shape as the fibula moves relative to the tibia. Trigonometric solution of these triangles defines the three components of planar movement, hence diastasis, of the fibula relative to the tibia. This device has since been used to measure tibiofibular diastasis in biomechanical comparisons of repairs using a screw versus a staple.

EVALUATING THE MECHANICAL AND POLYMERIZATION CHARACTERISTICS OF MODIFIED BONE CEMENTS. Peter C. Liacouras, Jennifer S. Wayne, & John R. Owen, Orthopaedic Research Laboratory Depts. of Biomedical Engineering and Orthopaedic Surgery, Virginia Commonwealth University, Richmond, VA 23298. Color additives to bone cements for total joint replacements allow for more readily distinguishable cement from surrounding bone tissue. It is unknown whether the additive alters the cement's polymerization characteristics or mechanical properties. This study evaluated several standard acrylic bone cement tests of Endurance, Surgical Simplex P, and a Pigmented Endurance (developed by DePuy, a Johnson and Johnson Company). Dough times for were found to be 3:40, 2:50, and 3:30 (minutes:seconds), respectively. Setting times were 7:35, 10:15, and 9:20. Compression strengths were: 86.30±4.23, 84.17±1.20, 90.67±3.79MPa. Tensile strengths were: 43.68±2.27, 47.30±4.39, and 45.37±2.34MPa. Flexural strengths were: 66.12±4.39, 70.78±6.877, and 66.25±3.69MPa with flexural moduli of 2769.32±85.90, 2728.58±105.07, 2741.03±22.33MPa. Statistical analysis (one-way ANOVA, Tukey's HSD post-hoc comparisons) revealed that the addition of pigment did not affect any of the mechanical properties of Endurance. Analysis revealed statistical equivalence between all cement types, with the exception of Compressive Strength where Pigmented Endurance was stronger than Simplex (p<0.02).

UTILIZING ELECTROSPINNING TO CONTROL FIBER DIAMETERS OF BIORESORBABLE POLYMERS FOR TISSUE ENGINEERING SCAFFOLDS. Eugene Boland<sup>1</sup>, Gary E. Wnek<sup>2</sup>, & Gary L. Bowlin<sup>1</sup>, Depts. of <sup>1</sup>Biomedical Engineering and <sup>2</sup>Chemical Engineering, Virginia Commonwealth University, Richmond, VA 23298. Research in the field of Tissue Engineering is striving to develop the ideal scaffold. This ideal scaffold must not hinder the normal function of tissues nor the differentiation and migration of cells yet it must provide adequate support to maintain the proper three-dimensional orientation. To achieve these ends, a scaffold must be penetrable to cells, identifiable as a substitute extracellular matrix (either by size or chemical structure), and provide the mechanical strength to support the developing tissue. These interactions are as critical in determining success or failure of engineered tissues. Utilizing electrospinning of Poly(glycolic acid),

Poly(lactic acid), and Polycaprolactone, we have created fibrous scaffolds that we believe can mimic the needs of the specific target tissues (Patents Pending). We have determined that fiber diameters vary linearly with polymer concentration in the spinning solution (from 100 nanometers to 10 microns), and fiber size, orientation, and spinning solvent control the mechanics of these scaffolds. Various geometries and properties are possible with our prototype electrospinning system in a quick and reproducible manner.

**ELECTROSPINNING OF COLLAGEN NANOFIBERS.** Jamil A. Matthews<sup>1</sup>, Gary E. Wnek<sup>2</sup>, David G. Simpson<sup>3</sup>, & Gary L. Bowlin<sup>1</sup>, Depts. of <sup>1</sup>Biomedical Engineering, <sup>2</sup>Chemical Engineering and <sup>3</sup>Anatomy, Virginia Commonwealth University, Richmond, VA 23298-0694. Electrospinning is a fabrication process that uses an electric field to control the deposition of polymer fibers onto a target substrate. This electrostatic processing strategy can be used to fabricate a wide range of fibrous polymer mats. In this study, we describe how electrospinning can be adapted to produce tissue-engineering scaffolds composed of collagen nanofibers (Patents Pending). Optimizing conditions for calfskin type I collagen produced a matrix composed of 100 nm fibers that exhibited the 67 nm banding pattern which is characteristic of native collagen. The structural properties of electrospun collagen varied with the concentration of the collagen solution used to spin the fibers. Electrospinning is a rapid and efficient process that can be used to selectively deposit polymers in a random fashion or along a predetermined and defined axis. Electrospun collagen promotes cell growth and the penetration of cells into the engineered matrix. In conclusion, the structural, material and biological properties of electrospun collagen suggest that this material may represent a nearly ideal tissue-engineering scaffold.

**EFFECTS OF PARKINSON'S DISEASE AND DEEP BRAIN STIMULATION ON EYE MOVEMENTS AND READING.** Charles Neering, Asma Habib, & Paul A. Wetzel, Dept. of Biomedical Engineering, Virginia Commonwealth University, Richmond, VA 23298. Parkinson's Disease (PD) is a progressive disorder that affects both neuromuscular and oculomotor control. This study was conducted to analyze the effects of deep brain stimulation (DBS) on eye and head movements in PD patients during reading. Both non-PD and PD patients with DBS devices read 10 randomly selected texts of equal character spacing and increasing difficulty level. Eye position was monitored by a pupil-corneal eye tracking system and translated into such parameters as fixation duration and average saccadic amplitude. Head position was sampled by a six-degree of freedom magnetic head tracking system. Periods of fixation instability in PD patients were observed to be associated with uncompensated, uncorrelated movements of the eye and/or the head. DBS devices were shown to reduce the frequency of these episodes of instability and improve PD patient reading ability. These episodes can lead to an inability to adequately stabilize fixation resulting in greater reading difficulty and reduced overall quality of life.

**AN EYE MOVEMENT BASED HUMAN MACHINE INTERFACE.** Federico A. Puma & Paul A. Wetzel, Dept. of Biomedical Engineering, Virginia Commonwealth University, Richmond, VA 23298. Certain diseases and disabilities may limit a person's ability to access a computer or to interact with other machines or devices using traditional input devices. A system is described that can be used as a communication aid for people with body or limb movement limitations. An interface is described that incorporates eye and head position measurement and utilizes a combined gaze measurement as an alternative input to control cursor movement on a computer. Transfer from mouse-cursor control to gaze-cursor control is done using a keyboard key. The system has been designed to operate in the background with other Windows based applications and will be evaluated for clinical and rehabilitation use.

PERFORMANCE OF ARTIFICIAL NEURAL NETWORKS IN THE PREDICTION OF LOWER TORSO MUSCLE RECRUITMENT PATTERNS. Miguel A. Perez & Maury A. Nussbaum, Grado Dept. of Industrial & Systems Eng., Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. Prediction of muscle recruitment patterns in the lower torso is useful in the modeling of low-back injury risk, especially in occupational manual materials handling tasks. While several mathematical models are available to predict muscle recruitment patterns, some disadvantages specific to the use of each model exist. Artificial Neural Networks circumvent many of these disadvantages and have been successfully used in problems of a similar nature. However, verification of the network's predictive performance had been somewhat limited in its scope. This investigation expanded the verification of a network's performance to high-magnitude static torso exertions involving tri-axial moments. Low levels of predictive performance (average  $R^2$ 's in the 0.20s) were initially observed, and prompted further experiments to understand the factors affecting the network performance. The results of these experiments indicate that the main sources of prediction error are the physiological parameters (e.g. muscle moment arms, maximum muscle stress) that have been used in the model. Current research efforts are being directed to identify and correct those parameters that generate substantial amounts of error in model predictions.

NEURAL NETWORK DESIGN OF A DISHWASHER CONTROL BOARD. Michael Morris & Rosalyn S. Hobson, Dept. of Electrical Engineering, Virginia Commonwealth University, Richmond, VA 23220. In this paper a novel approach to designing an advanced control board for use in appliance, and specifically dishwasher, control. A software model of a typical control board is constructed using Simulink to understand the control path to be designed, and is used as a benchmark for an innovative controller. Hardware control of the dishwasher is realized by use of the Invensys Control Systems tool used for hardware design. The 'brain' of the dishwasher is a neural network using the Widrow/Hoff learning method. Smart control is achieved using sensors, timing mechanisms, and the Widrow/Hoff neural network.

CLASSIFICATION OF VISUAL SEARCH USING NEURAL NETWORKS. Harsh Raju & Paul A. Wetzel, Dept. of Biomedical Engineering, Virginia Commonwealth University, Richmond, VA 23298. Visual search describes the process of how the head and eyes move in a visual field in order to acquire a visual object. A neural network based approach has been implemented to assess and objectively compare visual search patterns within and between observers. A hybrid Learning vector quantization neural network has been developed to perform translation, rotation and scale invariant (TRSI) visual search classification. Unrestricted head movement data collected during visual search of a stationary target in a hanger under different viewing conditions namely simulated daytime with unrestricted field of view (FOV), simulated daytime with 40° FOV and using night vision devices were analyzed. The neural network is coupled to a preprocessing stage that extracts features of the search pattern that are TRSI. A supervised learning rule, Learning vector quantization1 (Lvq1) was used to train the network. The network was able to classify the patterns with 90% accuracy under TRS conditions. Patterns were quantified and compared through computation of the correlation coefficient. A highly accurate neural network, vision model was developed and visual search was successfully quantified.

AN ANALYSIS OF FEEDING BEHAVIOR IN PRE-MATURE INFANTS. Patrick M. Boland<sup>1</sup>, Paul A. Wetzel<sup>1</sup>, Rita H. Pickler<sup>2</sup>, & Rosalyn S. Hobson<sup>3</sup>, <sup>1</sup>Dept. of Biomedical Engineering, <sup>2</sup>School of Nursing, and <sup>3</sup>Dept. of Electrical Engineering, Virginia Commonwealth University, Richmond, VA 23298. Premature infants, by definition, are neurologically underdeveloped. They have difficulty or inability in bottle-feeding which is manifested by a disorganized "suck, swallow and breathe" complex. The Pre-Term Readiness & Outcomes Study (PRO Study) tests a predictive model of bottle-feeding readiness and bottle-feeding outcomes and uses biomedical signal analysis as one of the research components. The analog signals collected include sucking (strain gauge), swallowing (EMG), respiration (piezoelectric nasal sensor), ECG, and oxygen saturation and pulse wave via pulse

oximeter. A feed-forward, multi-layer perceptron configuration using a backpropagation algorithm was implemented to differentiate between two of the data signals collected - suck and swallow - with only limited success. A Learning Vector Quantization (LVQ1) neural network algorithm was then used to analyze a series of two-second suck and swallow samples (targets) obtained at a 500-Hz sample rate. Eighty or fewer epochs with a learning rate of 0.01 were required to consistently train a network able to identify the test data with an accuracy of 100%.

**SPEECH PROCESSING IN HIGH NOISE.** Douglas G. Richards, Martin L. Lenhardt, & Alan G. Madsen, Dept. of Biomedical Engineering, Virginia Commonwealth University, Richmond, VA. Speech intelligibility is a problem in high noise environments (e.g., aircraft carrier flight decks). Although active noise cancellation technology can reduce the noise at low frequencies, it is of little use in the higher speech frequencies, where low-energy consonants convey much of the meaning in speech. We have developed digital signal processing algorithms for moving the consonants into a higher frequency region that is less susceptible to noise, and presenting those frequencies through bone-conduction transducers directly to the inner ear. The processing includes filtration to isolate the consonants, and modulation of carriers in the high audio (10-20 kHz) or ultrasonic (20-100 kHz) range. Bone conduction is accomplished through custom piezoelectric transducers and amplifiers.

### Botany

**THE FLORA OF VIRGINIA PROJECT: AN 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 plants of any state. It had the first flora, the *Flora Virginica* in 1739 by John Clayton, yet does not have a modern flora of Virginia. The Virginia Academy of Science for over fifty years has supported efforts to produce a modern flora. In 1999, renewed efforts to produce a modern flora were made through the VAS Botany Section and the Virginia Flora Committee. Financial support from VAS followed. In 2001 the Foundation of the Flora of Virginia, Inc. was formed to be the primary vehicle for the development and production of the *Flora of Virginia*, and its Board of Directors met in August, 2001. In early 2002 a Flora Advisory Board was formed, made up of 50 botanists from around the Commonwealth (including many VAS members). It met in February to develop guidelines for the format and other details of the *Flora of Virginia*. Alan Weakley, Curator of the UNC-Chapel Hill Herbarium, will be the first author of the *Flora*. Chris Ludwig, Division of Natural Heritage, is Executive Director of the Project and will be the second author. He will be permitted to direct the Project as part of his position duties. Federal tax-exempt [501(c)3] status has been granted for the Project and serious fund-raising and public outreach are going forward.

**ACALYPHA DEAMII EAST OF THE APPALACHIANS.** Patricia A. Truman<sup>1</sup>, Gary P. Fleming<sup>2</sup>, & W. John Hayden<sup>1</sup>, <sup>1</sup>Department of Biology, University of Richmond, VA 23173 and <sup>2</sup>Virginia Department of Conservation & Recreation, Division of Natural Heritage, 1500 E Main St., Richmond, VA 23219. Until recently, *Acalypha deamii* was thought to be a relatively rare species restricted to flood plains of the Ohio and mid-Mississippi River systems. We report the presence of this frequently overlooked species in Virginia, Maryland, and eastern West Virginia. Since 1997, our field work has amassed over 50 collections of *A. deamii* from floodplain forests of the James, Roanoke/Stanton, Rappahannock, Shenandoah, and Potomac rivers. Typical habitat for *A. deamii* has considerable microtopographic diversity including periodically flood-scoured areas with high surface cover of exposed sandy soil. These soils are moderately acidic but fertile with moderately high calcium, magnesium, and manganese levels and high total base cation saturation. Frequent associates are annual herbs and delicate perennials. Along with *A. virginica*, *A. rhomboidea*, and *A. gracilens*, *A. deamii* is a member of the so-called *Acalypha virginica* complex resembling most closely the



widespread and weedy *A. rhomboidea*. *Acalypha deamii* can be recognized by its robust stature, broad leaves, 2-carpellate gynocelia, large (2.2-3.2 mm) seeds, and allomorphic flowers and fruits.

INITIATION AND FIRST RESULTS OF A FLORISTIC INVENTORY FOR RANCHO KIUIC, YUCATAN. W. John Hayden, Department of Biology, University of Richmond, VA, 23173. The opportunity to document vascular plant diversity at the Helen Moyers Bio-Cultural Reserve located at Rancho Kiuc, Yucatan, Mexico, grew from the author's participation in an environmental citizenship experiential learning course taught in collaboration with colleagues at Millsaps College and the Autonomous University of Yucatan (UADY). Reported here are initial stages in the development of the inventory. Rancho Kiuc is located within the Puuc Hills, a region of modest relief within the otherwise very flat Yucatan peninsula. Throughout the region, much of the forest is maintained at early successional stages because of clearing for pasture or swidden agriculture. The forest at Kiuc, however, is older and more mature than that of most of the surrounding area. So far, field work has sampled vegetation in December (dry season), early June (cusp between dry and wet seasons), and late July (wet season). Presently the inventory consists of 214 species documented with vouchers at UADY and/or UR. Leguminosae and Euphorbiaceae are particularly abundant. The flora is being documented via digital photography and early stages of development of photographic aids to plant identification are being developed.

AN INTERNET-BASED INVENTORY OF THE TREES AND SHRUBS OF THE UNIVERSITY OF RICHMOND CAMPUS. Tihomir S. Kostadinov & W. John Hayden, Department of Biology, University of Richmond, VA 23173. An Internet-based resource for the woody dicotyledonous plants growing on the University of Richmond campus was created during the summer of 2001. Both exotic and native trees and shrubs were included in the study. More than 170 woody dicotyledonous species were documented, in 44 angiosperm families. Each species is represented by a unique page including one or more high-resolution digital photographs accompanied by a brief botanical description derived from standard literature. Herbarium specimens were collected for each species; these vouchers are identified on the website and are located at the University of Richmond Herbarium (URV). In addition, the web site features a brief introduction to the physical environment of the UR campus, some statistics, and lists of species sorted by family, genus, and common name. The web site has many potential uses for pedagogy in biology, botany, horticulture, and natural history. It is available to the public at: <http://www.mathcs.richmond.edu/~tkostadi/trees/>

A COASTAL FOREST'S RESPONSE TO RISING SEA LEVEL ON THE DELMARVA PENINSULA, MARYLAND. M.L. Kirwan, College of William and Mary, Williamsburg, VA 23186 and J. L. Kirwan & C. A. Copenheaver, College of Natural Resources, Virginia Tech, Blacksburg, VA 24061. To address the impact of rising sea level on a Maryland coastal forest, 15 loblolly pines (*Pinus taeda*) were cored for dendroecological analysis. The studied forest is a pure stand of loblolly pine that extends down an elevation gradient into surrounding marsh. Dead stumps and snags in the marsh indicate a retreating forest margin. Although relative sea level has risen considerably, there is no associated decline in ring width and likely no associated mortality. Instead, ring width is correlated positively with annual precipitation and winter temperature and negatively with summer temperatures. Although recruitment of new individuals was continuous between 1910 and 1930, there has been no more active recruitment except for a small age class established immediately after regional drought. Because recruitment is failing in the present forest despite abundant seedlings and a loose canopy, recruitment ability appears to be limited by saturated soils associated with periods of high sea level. The forest margin will retreat stepwise, following storm induced mortality or continuously, following natural adult mortality. The position of the forest margin is then a function of sea level position, but it represents the failure to recruit new individuals, not the ability of adults to survive.

COMPARISON OF NUCLEAR- AND CHLOROPLAST-BASED PHYLOGENIES IN *ILLIAMNA* (MALVACEAE). Tracey A. B. Slotta and Duncan M. Porter, Dept. of Biology, Virginia Polytechnic Inst. & State Univ., Blacksburg, VA. Sequences from the internal transcribed spacer (ITS) of the nuclear ribosomal region and the trn L-F spacers of the chloroplast genome were used to resolve relationships in *Iliamna* Greene (Malvaceae). The eight species of *Iliamna* were included as well as representatives from *Malacothamnus*, and *Phymosia*. *Iliamna*, *Malacothamnus*, and *Phymosia* are thought to comprise the *Malacothamnus* Alliance based on chromosome numbers and morphological similarities. Preliminary results in the present study indicate a strong affinity between *Iliamna*, *Malacothamnus*, and *Phymosia*. Sequences from the ITS region of *Iliamna* contained several insertion/deletion events preventing direct sequencing; whereas, in *Malacothamnus* and *Phymosia*, these events were not detected. This finding supports the hypothesis that *Iliamna*, with a base chromosome number of  $n = 33$ , is a polyploid possibly derived from either *Malacothamnus* or *Phymosia*, in which  $n = 17$ . Topology of the phylogenies was examined and a few rearrangements of clades were found. It appears that *Iliamna* may not be monophyletic, and that a few species may belong in another genus. Additional sampling from a wider variety of potential relatives is required before a clear picture of the evolutionary history of the genus can be developed.

NEUSTON PHYTOPLANKTON: A UNIQUE COMMUNITY WITHIN AQUATIC HABITATS. Harold Marshall<sup>1</sup> and Lubomira Burchardt<sup>2</sup>, Dept. Biological Science, <sup>1</sup>Old Dominion University, Norfolk, VA. Dept. Hydrobiology & <sup>2</sup>Adam Mickiewicz Univ., Poznan, Poland. The algal populations within the neuston surface micro-layer (2-3 mm in depth) using a glass plate collection protocol, were collected from a small (0.23 ha) pond and Lake Drummond in southeast Virginia. Collections were made between August 2001 and March 2002, with sub-surface phytoplankton collected for comparison. The pond contained a diverse representation of species (39) in the neuston, with the flora dominated by blooms of chlorophytes (*Scenedesmus* spp.) in August, diatoms (*Nitzschia acicularis*) in January, and cyanobacteria (*Aphanizomenon flos-aquae*) in March. There was less diversity (23 species) in Lake Drummond neuston which was dominated by a variety of diatoms, which produced a bloom of *Asterionella formosa* during January and February, with other diatoms also dominant (e.g. *Aulacoseira herzogii*). Total neuston concentrations ranged from 0.5 to  $1.3 \times 10^3$  cells l<sup>-1</sup> in the Lake Drummond, with sub-surface phytoplankton concentrations at 0.2 to  $2.7 \times 10^3$  cells l<sup>-1</sup>. Total neuston in the pond ranged from 16.5 to  $57.0 \times 10^3$  cells l<sup>-1</sup>, with sub-surface neuston concentrations at 19.4 to  $40.4 \times 10^3$  cells l<sup>-1</sup>. In general, similar taxa were observed in both the neuston and sub-surface collections.

HISTORICAL ENVIRONMENTAL CHANGE IN LAKE DRUMMOND OF THE GREAT DISMAL SWAMP. Jeremy L. Hicks & Jennifer E. Slate, Dept. of Biol., Old Dominion Univ., Norfolk, Va 23529. Lake Drummond of the Great Dismal Swamp is one of two naturally occurring lakes in Virginia. The water is highly acidic and tea-colored due to the great influx of organic matter. To determine water quality change in Lake Drummond since European settlement, a variety of paleoecological techniques will be employed. From preliminary microfossil diatom analysis and organic/inorganic composition of a 19-cm sediment core, it is hypothesized that deforestation began at 12-13 cm depth. Benthic diatom species increased and inorganic content (possibly sand) was high. At 4-5 cm depth, another peak in inorganic mass occurred, which was possibly caused by increased erosion due to canal digging. This increase in erosion could have caused nutrient concentrations to increase in the lake. More data will be obtained, including <sup>14</sup>C and <sup>210</sup>Pb dating of sediment, inorganic and organic sediment chemistry, and sediment grain-size analysis. Analysis of chrysophyte cysts, sponge gemmoscleres, and plant phytoliths may also prove valuable.

SPECIATION IN AQUATIC PLANTS: A CASE STUDY IN WATER LILIES. Kristi Niehaus, Khidir W. Hilu, Dept. of Biol., Virginia Polytechnic Inst. & State Univ., Blacksburg, VA 24060, & Thomas B. Borsch, Dept. of Systematics and Biodiversity, Univ. of Bonn, Germany. *Nymphaea odorata* is the most common water lily in North America. A recent classification accepts two

subspecies: subsp. *odorata* and subsp. *tuberosa*. The closest relative of *Nymphaea odorata* is *N. mexicana*, which overlaps with subsp. *odorata* from Texas to Florida. Subspecies *tuberosa* occurs further north. We studied patterns of variation and speciation in *N. odorata* using morphology and sequence data from ITS and *trnT-F*. We sampled 43 populations across the range of *N. odorata* and four *N. mexicana* populations. We examined 40 morphological characters with univariate analysis, SAHN clustering, and PCA. Morphology was highly variable, with no significant grouping by either subspecies or geography. ITS sequences revealed the potential presence of different paralogues and point to gene flow between and within the two subspecies. Subspecies *tuberosa* seems to be characterized by a different cpDNA haplotype. Parsimony and NJ analyses of nrDNA sequence data excluding the apparently heterozygous individuals revealed two clades representing the two subspecies.

PRELIMINARY ANALYSIS OF ISSR BANDING PATTERNS IN THE *SILPHIUM ASTERISCUS* COMPLEX. Jennifer A. Clevinger, Curtis C. Clevinger, Steven M. Bernacki, Jennie H. Fairservice & Cassidy L. Turner, Department of Biology, James Madison University, Harrisonburg, VA 22807. The genus *Silphium* L. is a member of the sunflower family Asteraceae. It is primarily distributed in the eastern United States. Previous phylogenetic analyses support the division of *Silphium* into two sections, *Silphium* and *Composita*, based upon DNA sequences and growth form. Within these two sections, some clades lacked sufficient variation in the internal transcribed spacer (ITS) and external transcribed spacer (ETS) regions of nrDNA for resolution. One such clade contained two Appalachian endemics, *S. brachiatum* and *S. mohrii*, and the geographically widespread *S. asteriscus* complex. Four additional cpDNA regions have been preliminarily sequenced for this clade but were found to have less than 0.1% variation. Currently, samples from the *S. asteriscus* complex, *S. mohrii* and *S. brachiatum* are being assayed for inter-simple sequence repeat (ISSR) regions. Six of ten primers tested so far have shown variation and are being analyzed. The ISSR banding patterns will allow us to resolve relationships within this poorly understood clade.

IN VITRO REGENERATION OF *SAINTPAULLIA RUPICOLA*. Michael H. Renfro & Evonne N. Johnson, Dept. Biol., James Madison Univ., Harrisonburg, VA 22807. Kenya is home to the endangered species of African violet *Saintpaulia rupicola*. Loss of habitat and changing environmental conditions threaten to eliminate this species from the wild. One approach to conserving this species and the genetic resources that it possesses is to clonally propagate members of this species without removing the original plants from the wild. In order to accomplish this task, conditions required for in vitro regeneration of this species must be understood. To determine the requirements for in vitro clonal propagation, we collected axenic leaf explants and placed them on a tissue culture medium containing various combinations of benzylaminopurine (BAP) and naphthaleneacetic acid (NAA). Best shoot regeneration occurred when BAP was in high concentration relative to NAA. Media discoloration occurred during the culture period. Attempts were made to reduce media discoloration by inclusion of ascorbic acid, polyvinylpyrrolidone, or activated charcoal. Only activated charcoal reduced discoloration, but shoot regeneration also declined with this treatment. Differential responses were noted among genotypes tested. Results indicated that genetic variation was present among the sample population and that in vitro propagation was feasible for this species of African violet.

ANALYSIS OF INTERSPECIFIC AND INTRASPECIFIC INTERACTIONS BETWEEN *AILANTHUS ALTISSIMA* AND *ROBINIA PSEUDOACACIA*. Lara J. Call & Erik T. Nilsen, Dept. of Biol, Virginia Tech, Blacksburg, Va 24060. The exotic invasive *Ailanthus altissima* and the native *Robinia pseudoacacia* are frequently found in disturbed sites, exhibit similar growth and reproductive characteristics, yet have distinct functional roles such as allelopathy and nitrogen fixation, respectively. 1) A full additive series in the greenhouse and 2) spatial point pattern analysis of trees in the field were used to analyze the intraspecific and interspecific interference between these species. In the greenhouse, total biomass responses per plant for both species were significantly affected by

interspecific interference. Indices such as Relative Yield Total and Relative Crowding Coefficient suggested that *A. altissima* was the better competitor in mixed plantings for above ground and below ground interactions. Yet, *R. pseudoacacia* had larger aboveground relative yield in high density mixed pots and greater mean biomass responses for multiple biomass traits. Analysis of spatial point patterns in the field indicated that the two species were positively associated along highly disturbed skid trails in the majority of the field sites. Locally, increased disturbances could lead to more opportunities for *A. altissima* to invade, negatively interact with *R. pseudoacacia*, and become established in place of native species.

THE USE OF REAL-TIME MOLECULAR DIAGNOSTICS FOR THE RAPID DETECTION OF THE DINOFLAGELLATES *PFIESTERIA PISCICIDA* AND *P. SHUMWAYAE*. Sheryl Lynne Walton, Wayne Hynes, & Harold Marshall. Dept. of Biol. Sci., Old Dominion Univ., Norfolk, Virginia 23529. *Pfiesteria* spp. are toxic dinoflagellates that have been found to be associated with fish-kills in rivers and estuaries in North Carolina and other areas along the east coast of the United States. The dinoflagellates have also been found to be associated with human illness, specifically Possible Estuary-Associated Syndrome (PEAS). Due to the public health ramifications that the presence of toxic dinoflagellates may have on a fishing or recreational community, the CDC implemented a monitoring of the various rivers and estuaries along the southeast coast of the Atlantic Ocean for *Pfiesteria* and *Pfiesteria*-like organisms beginning in June 1998. In the past, more traditional methods for detection of the various dinoflagellates were labor-intensive and timely to ascertain the causative agent for a fish-kill; however, in order to increase the public health response to the presence of toxic dinoflagellates, more rapid forms of detection were developed by various laboratories. For a more rapid detection of *Pfiesteria* spp. and *Pfiesteria*-like organisms in the various rivers and estuaries along the Chesapeake Bay, our lab has adapted and implemented molecular techniques, including quantitative and multiplex real-time quantitative assays. Here, we present the development and sensitivity for each of these assays for the various dinoflagellates. This work was supported by VDH and CDC.

DISTRIBUTION OF TREE SPECIES ALONG A FLOODING GRADIENT IN ARKANSAS COASTAL PLAIN SWAMPS. Edward E. Dale, Jr., Dept. of Biol. Sci., Univ. of Arkansas, & Stewart Ware, Dept. of Biol., Col. of Wm. & Mary. In floodplains of the Gulf Coastal Plain, Arkansas Valley, and Mississippi Valley in Arkansas, transects were run from sloughside or streamside outward until upland forest was encountered. First rise to dominance was recorded for each dominant tree species along each transect. By comparison of transects, elevational order of rise to dominance (= presumed flooding tolerance) could be ascertained for 20 species, with classification as backwater, riparian, or both. The backwater sequence was baldcypress (wettest), water tupelo, buttonbush, water elm (*Planera*), swamp privet (*Forestiera*), water locust, overcup oak, water hickory, Nuttall oak, green ash, southern hackberry, American elm, boxelder, sweetgum, willow oak, water oak, cherrybark oak, and shagbark hickory. The riparian sequence was black willow, buttonbush, cottonwood, water hickory, green ash and thereafter like the backwater sequence. In 58 quantitatively sampled stands, shagbark hickory, boxelder, and southern hackberry were important in wetter sites than predicted by transect data. Cedar elm far exceeded American elm in abundance. Red maple, swamp chestnut oak, black gum, laurel oak, and pumpkin and Carolina ashes were absent or rare at all sites.

SCANNING ELECTRON MICROSCOPIC EXAMINATION OF A PFIESTERIA-LIKE DINOFLAGELLATE. Mikolaj Kokocinski and Harold Marshall. Dept. Biological Science, Old Dominion University, Norfolk, VA 23529-0266. Thecal plate tabulations for two dinoflagellates identified as belonging to the *Pfiesteria*-like complex were examined under SEM and compared to *Pfiesteria piscicida* and *P. shumwayae*. Cell cultures CCMP-1833 and CCMP-1838 were obtained from the Center for Culture of Marine Phytoplankton (CCMP). *Pfiesteria* spp. cultures was provided by Dr. JoAnn Burkholder (NCSSU). Sub-cultures were established in our laboratory and fed

*Rhodomonas* sp. (CCMP-757) in filtered and autoclaved sea water (10-15 ppt) in an incubator at 24.5°C and a 12:12 hour light:dark regime. A suture-swelling technique (Truby, 1997) was used for SEM examination. The plate patterns for CCMP-1833 and CCMP-1838 were similar, being: 4', 2a, 6'', 6c, 4s, 5''', 0p''', 2'''. However, there was a distinct difference in the size of the diamond-shaped intercalary plates, with larger anterior intercalaries (1a, 2a) present in CCMP-1838. In CCMP-1838, these anterior intercalaries (1a, 2a) are much larger than in CCMP-1833. Also, the two taxa differ in size, with CCMP-1833 < 15 µ and CCMP-1838 > than 15 µ. Neither CCMP-1833 or CCMP-1838 had plate patterns and tabulations similar to *Pfiesteria* spp.

RESULTS OF THE VIRGINIA MONITORING PROGRAM FOR PFIESTERIA SPECIES AND PFIESTERIA-LIKE ORGANISMS (PLO). M. Braynard, J. Hicks, T. Stem, T. Egerton, J. McNally, C. Taylor, S. Walton, M. Kokocinski, & H.G. Marshall. Dept. Biol. Sci., Old Dominion University, Norfolk, VA 23529-0266. The *Pfiesteria* spp. and *Pfiesteria*-like organisms have been monitored monthly and/or twice monthly from over 100 Virginia estuarine sites from May through October since 1998. Cells from water samples with high PLO counts are established in clonal cultures, examined with scanning electron microscopy for plate tabulation, and used in fish bioassays to determine toxicity. Final confirmation is conducted through PCR analysis, with cross-confirmation of species identified with laboratories at NCSU, UNC, and UMD. PLO occurred in over 90% of the samples and concentrations ranged from 0 to 49,000 cells/ml. The most common PLO were *Gyrodinium* spp., *Cryptoperidiniopsis* spp., *Gymnodinium* spp., and *Karlodinium micrum*. Highest cell concentrations occur from May through July, in waters of 10-20 ppt, and temperatures >20°C. In 2001, over 1200 water samples were analyzed during this period. From these, *P. shumwayae* was identified in the Pagan River and East River, with *P. piscicida* not present in the samples. However, toxic strains of both *Pfiesteria* spp. and various PLO have been maintained in our laboratory for life cycle and bioassay studies.

STATUS AND LONG-TERM TRENDS IN PHYTOPLANKTON POPULATIONS IN THE CHESAPEAKE BAY AND SEVERAL VIRGINIA TRIBUTARIES. T. Stem, J. McNally, J. Hicks, M. Braynard, T. Egerton, K. Alperin, M. Lane, K. Nesius, and H.G. Marshall. Dept. of Biological Science, Old Dominion University, Norfolk VA, 23529-0266. Based on a 15 year data set, these waters continue to be dominated by a diatom flora, which have major growth pulses in spring, summer, and fall. The summer flora is composed of an assemblage of diatoms, cyanobacteria, and phytoflagellates. Potential toxin producing species (14) have been identified and are being monitored. There are increased trends in total phytoplankton abundance and biomass, with mixed patterns among the various nutrients. There is a decreasing trend in productivity over this period (1985-2001), which is accompanied at various sites by increased TSS and reduced Secchi readings. No significant trends were associated with various phytoflagellates, cyanobacteria, or the autotrophic picoplankton. However, of concern in both the Bay and tributaries in recent years is an increased abundance of cyanobacteria and the frequent occurrence of dinoflagellate blooms within the lower reaches of the rivers. Most recently (2002) there was the extended bloom of *Dinophysis acuminata* (a toxic dinoflagellate) in several Virginia inlets of the Potomac River.

## Chemistry

SYNTHESIS AND CHARACTERIZATION OF COMPLEXES OF Co(II), Ni(II), Cu(II) AND Zn(II) WITH AMIC ACID LIGANDS AS MOLECULAR MODELS FOR METAL-DOPED POLYIMIDES. Takya Ahmed, D.L. Polo, L.M. Vallarino & J.W. Williams, Department of Chemistry, Virginia Commonwealth University, Richmond, VA 23284-2006. This work is part of an ongoing class project that investigates the coordinating ability of the amic acid sites of polyimides through a study of the metal complexes of representative monomeric amic acid models. The ligands, N-(2-methylphenyl)phthalamic acid (H-oMeNPPA) and N-(2-methoxyphenyl) phthalamic acid (H-

oMeOxNPPA), were synthesized by condensation of phthalic anhydride with the appropriate substituted aniline. They were then reacted with the metal acetates to yield complexes of the general formula  $ML_2 \times (\text{solvent})_n$ , where  $n = 0.5 - 1.5$  of the solvent acetic acid, water and/or ethanol. The complexes of Co(II), Ni(II) and Zn(II) had identical IR spectra and solubility patterns. On the basis of the d-d electronic spectra of the Co(II) and Ni(II) species, and of the  $^1\text{H}$  NMR spectrum of the Zn(II) species, these complexes were assigned a six-oxygen-donor octahedral geometry with the amic acid anions acting as ligands *via* the carboxylate groups. The less soluble Cu(II) complex, which had a somewhat different IR spectrum, was instead assigned a dimeric structure with bridging carboxylates.

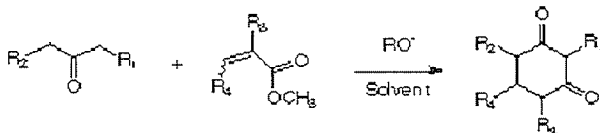
TEMPERATURE PROGRAMMED DESORPTION OF PRIMARY ALCOHOLS FROM ALUMINA. Thomas C. DeVore, Dept. of Chem., James Madison University, Harrisonburg VA 22807. The desorption of methanol, ethanol, 1-propanol, 1-butanol, and 1-pentanol from calcined boehmite in vacuum at temperatures between 300K and 700 K was investigated using temperature programmed desorption - FTIR spectroscopy. The desorption pattern was similar for all of the alcohols tested. The alcohol began desorbing at temperatures as low as 300 K, the ether begins desorbing at  $\sim 450$  K, and the 1-alkene is first observed at  $\sim 525$ K for all alcohols except methanol. The kinetics for each process has been determined. Semi-empirical calculations ( $\text{PM}_3$  level) for methanol on a model boehmite surface indicated that the alcohol binds to the aluminum atoms on the surface. Dissociation of the alcohol on adjacent acid-base sites is energetically favorable and could be a step in the mechanism leading to the observed products. This project was funded by NSF-CHE-0076685, NSF-REU-0097448, and NSF-REU-0097449.

SYNTHESIS OF 3-ACYLINDOLES. Saeid Esmailian & Wayne M. Stalick, Department of Chemistry, George Mason University, Fairfax, VA 22030-4444. The development of a two-step approach to the synthesis of direct  $\gamma$ -carboline precursors is a topic of interest in our laboratory. It is possible to make 3-acylindoles in one step from indole and acyl halides using a mild Friedel-Crafts catalyst, in this case,  $\text{SnCl}_4$ . A series of these 3-acylindoles have been synthesized so they possess a variety of pendent groups, that will eventually end up as 1-position substituents in the final  $\gamma$ -carboline products. 3-acylindoles exhibit biological activities. Many simple indole derivatives show predominately excitatory actions, and a considerable number of 3-acylindoles reportedly show anticonvulsant actions. In the synthesis, whenever the Lewis acid is added to the reaction mixture containing indole and the acylating agent, a strong color change occurred. Under such Friedel-Crafts condition indole trimers and monoacylated indole trimers are produced along with a minor quantity of 3-acylated indole. Changing the addition order, adding  $\text{SnCl}_4$  to a solution of only indole in  $\text{CH}_2\text{Cl}_2$  at  $0^\circ\text{C}$  followed by the addition of acylating agent, allowed for the production of 3-acylindoles as the major product. Another change, addition of nitromethane as a co-solvent, helps to reduce the reaction time. It also increases the solubility of the solid indole-Lewis acid complex, resulting in increased yield.

PROGRESS IN DEVELOPMENT OF NOVEL OXIDATIVE PROCESSES. Christopher T. Llovd, James H. Wynne & Robert F. Cozzens, Chemistry Division, Naval Research Laboratory, 4555 Overlook Ave, Washington, DC 20375. In the past few years, we have sought to further develop an environmentally friendly, atom-economical methodology for the oxidation of primary and secondary alcohols to their corresponding aldehydes and ketones. Such a method would be ideally suited for many industrial processes. We wish to discuss our recent findings *en route* to optimizing this oxidative methodology. The optimization process involves investigating the effects of varying catalyst/co-catalyst and oxidant concentrations, as well as reaction times and temperatures. Several organometallic transition metal catalysts are employed along with a variety of phase transfer catalysts. Hydrogen peroxide and air are employed as the oxidants in the process. The stability and longevity of the metal catalyst is proportional to the concentrations of the PTC; lesser amounts of PTC result

in catalytic deactivation and poisoning. Recent advances and scale-up potential are discussed in detail.

REGIOSELECTIVE ROUTES TO VARIOUSLY SUBSTITUTED CYCLOHEXANE-1,3-DIONES. Samuel A. Simpson, Belhu Berhanu & Godson C. Nwokogu, Dept. of Chem., Hampton Univ., Hampton, VA 23668. Cyclohexane-1,3-diones are versatile starting materials for the syntheses of complex aromatic and non-aromatic organic molecules. Up to four substituents can be introduced on the ring during its assembly from appropriately substituted ketones and acrylate ester. This one-pot synthesis led to inseparable mixtures of regioisomers with unsymmetrical ketones but was a clean, high yield reaction with symmetrical ketones. For pure samples of unsymmetrically substituted cyclohexane-1,3-diones, a multi-step route involving a synthetic equivalent of unsymmetrical ketones, was shown to lead to a single regioisomer, with many of the individual steps being high yield reaction.



EVALUATION OF STATE OF THE ART ANALYTICAL TECHNOLOGIES FOR THE STUDY OF PESTICIDES AND OTHER PERSISTENT ORGANIC POLLUTANTS. Gervais E. Assey & Isai T. Urasa, Dept. of Chemistry, Hampton University, Hampton, VA 23668. The research presented in this paper is a comparative evaluation of the analytical capabilities of modern analytical technologies for measurements of persistent organic pollutants (POPs), with emphasis on selected pesticides. The analytical techniques of interest include: High Performance Liquid Chromatography coupled with Diode Array Detector (HPLC-DAD), High Performance Liquid Chromatography coupled with Mass Spectrometric Detector (HPLC-MSD), Gas Chromatography coupled with Flame Ionization Detector (GC-FID), and Gas Chromatography coupled with Electron Capture Detector (GC-ECD). The analytes of interest represent three classes of pesticides, namely: organophosphates, organochlorides, and carbamates. The aim is to determine the optimal measurement parameter requirements, detection capabilities, and measurement selectivity. For purposes of enhancing measurement sensitivity, the research has also integrated solid phase extraction (SPE) with the analytical technologies in question, utilizing reversed phase stationary phase and locally developed biosolids. The results obtained to date indicate that the three classes of pesticides differ significantly with respect to their response to each of the analytical technologies. Furthermore, while organophosphates and carbamates appear to be quite responsive to preconcentration, achieving two-to-three orders of magnitude improvement in detection limits, the organochlorides show very little response to preconcentration.

SYNTHESIS OF THIOLS FOR CHEMICAL SENSOR APPLICATIONS. James H. Wynne, Christopher T. Lloyd & Arthur W. Snow, Chemistry Division, Naval Research Laboratory, 4555 Overlook Ave, Washington, DC 20375. In light of recent events, the demand for novel chemical micro-sensors has expanded exponentially. We report the synthesis of a unique series of functionalized thiols for use in chemical sensor applications. The transformation of a series of functionalities such as olefins, halides and tosylates into thiols is accomplished utilizing three facile routes. The utilization of these novel thiols in the formation of gold cluster micelles results in an excellent sensor that responds electrically, when exposed to a variety of vapors including organic solvents. A series of electrical response experiments was performed to evaluate each of the functionalized thiols to obtain a correlation and to maximize response to the molecules of interest. Additional efforts are underway to incorporate these sensors into a variety of real time detection devices. Synthetic challenges, sensitivity and application of these materials are discussed in detail.

GUANINE-7-METHYLTRANSFERASE: ACTIVE SITE LABELING WITH RNA AND DNA. Amber R. Bonham & Thomas O. Sitz, Dept. of Biochemistry, Virginia Tech, Blacksburg, VA 24061. The 5'-cap structure of eucaryotic mRNAs are modified through methylation by the enzyme guanine-7-methyltransferase (GMT). Without the methylation on the guanine base the mRNA does not function and therefore the mRNA is not translated into protein. We have been able to label the active site of this enzyme by cross-linking  $^{32}\text{P}$ -labeled DNA and RNA to the GMT with short wavelength UV light. We wanted to determine if the active site of GMT can discriminate between labeled DNA and RNA. We used a DNA oligo 11 deoxynucleotides long (11mer) and an RNA oligo 11 nucleotides in length (11mer) in the experiments. The DNA and RNA used are of the same sequence with the only differences being that DNA contains thymine while RNA contains uracil and DNA is composed of deoxyribose while RNA is made of ribose. The 5'-ends of the 11mer DNA and 11mer RNA were labeled with the enzyme polynucleotide kinase and  $\gamma\text{-}^{32}\text{P}$ -ATP. With the use of MALDI-TOF mass spectrometry we were able to verify that the DNA and RNA were the same nucleotide length. These nucleic acids were bound and cross-linked to the GMT enzyme and analyzed on an SDS polyacrylamide gel. The enzyme guanine-7-methyltransferase binds DNA and RNA equally.

A COMPARISON OF SUBUNIT STRUCTURE OF THE GUANINE-7-METHYLTRANSFERASE IN MOUSE AND HUMAN. Heidi L. Miller & Thomas O. Sitz, Dept. of Biochemistry, Virginia Tech, Blacksburg, VA 24061. The methylation of the 5'-cap structure in eucaryotic mRNA is important in order to have a functional mRNA. Earlier research from this laboratory determined that the mouse guanine-7-methyltransferase (GMT) had a subunit size of 46,000 daltons on SDS-PAGE. Recent analysis of the cDNA sequences of mouse and human has predicted that the mouse and human GMT enzyme have molecular weights of 53,000. We wanted to determine the native molecular weights of the mouse and human GMT. Using gel exclusion column chromatography on an FPLC Superose 6 column, we found that the mouse GMT has a molecular weight of 97,000–120,000 daltons (depending on the fraction size collected). These results suggest that the mouse enzyme functions as a dimer. When compared with human GMT isolated from HOS cells, there were two peaks of activity. One peak was 142,000 daltons, and the second was 49,000 daltons. Human GMT can be found in both a monomer and dimer form. When human GMT was fused with glutathione transferase and expressed in *E. coli*, the molecular weight was found to be 180,000, which is most likely a dimer consisting of two subunits. Therefore, the mouse GMT is only active in the dimer form, while human GMT is active in both monomer and dimer forms.

HIGH RESOLUTION INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETER (HR-ICP-MS): A POWERFUL TECHNIQUE FOR ULTRA-TRACE ELEMENTAL AND ISOTOPE RATIO ANALYSES. Zhongxing Chen, Laboratory for Isotope and Trace Element Research, Department of Chemistry and Biochemistry, Old Dominion University, Norfolk, VA23529 & Cynthia M. Jones, Center for Quantitative Fisheries Ecology, Old Dominion University, Norfolk, VA23529. Since its commercial introduction in the early 1980s, inductively coupled plasma mass spectrometry (ICP-MS) has been widely used as a multi-element analytical technique for trace elemental determinations and isotope ratio measurements in various disciplines. However, limited sensitivity and low mass resolution of traditional quadrupole ICP-MS cannot meet two growing analytical demands, *i.e.*, lower detection limits and resolution of interferences. Recently installed at the Laboratory of Isotope and Trace Element Research of Old Dominion University, the new Finnigan MAT high resolution magnetic sector ELEMENT 2 high resolution (HR)-ICP-MS provides scientists a powerful technique to perform ultra-trace elemental and isotopic analyses. With sensitivity higher than 1.0 billion counts per second (cps) per ppm and dark noise less than 0.2 cps, elemental concentrations down to ppt (even ppq for some elements) levels can be measured. The determination of elements such as Fe, V, As, and Se has been problematic with conventional quadrupole ICP-MS because of the limited mass spectral resolution of that instrument. However, the high resolution capability of our HR-ICP-MS allows most of these elements to be distinguished from the interfering masses. A UV laser ablation (LA) system coupled with the HR-ICP-MS provides *in-situ* determinations of a wide range of trace element and isotope composition in solid. In this study, we present the performance of our HR-ICP-



MS and its application to ultra-trace elemental concentration determinations and isotope ratio measurements in marine, geological, environmental, biological, and nuclear samples.

PHYTOESTROGENS IN BEER AND WINE. Roy L. Williams & Mark Elliott, Old Dominion Univ, Enological Research Facility, Dept. of Chem./Biochem., Old Dominion Univ., Norfolk, Va. 23529. This laboratory has been known for its research related to wine and health and the study of the phytochemical composition of wine, grape seeds and more recently soy products. The positive health benefits associated with moderate, responsible consumption of wine has been related to the levels of various phytochemicals including the isoflavonoids and stilbene phytoestrogens in the wine. Earlier studies have shown that the levels of these phytochemicals can be enhanced by fermentation of wine on the appropriate grape seeds. We have now adapted this seed enhancement approach to the production of a phytochemically enhanced beer. Soybeans are known to contain high levels of certain phytochemicals including genistein, daidzein and trans-resveratrol (TR). We have now produced a soy-enhanced beer, which is rich in these phytochemicals, by the addition of a soybean extract during the fermentation process. The resulting beer is exceptionally high in genistein, daidzein and TR and constitutes a beer with enhanced positive health factors compared to other commercial beers. The method of production and high-pressure liquid chromatographic analysis of this soy-enhanced beer will be discussed.

NATURAL ENDOCRINE DISRUPTERS IN DRINKING WATER. Joshua Richey & Roy L. Williams, Dept. of Chem./Biochem., Old Dominion Univ., Norfolk, Va. 23529. Endocrine disrupters (EDCs) are organic compounds, which can effectively compete with natural estrogens for the estrogen receptor and cause some degree of activity at this receptor. The presence of a variety of synthetic organic EDCs have now been observed in drinking water and their presence is of considerable significance with regard to potential public health effects. Natural EDCs such as the phytoestrogens genistein, daidzein and trans-resveratrol (TR) have not been detected in drinking water supplies to date but their presence in certain types of raw waters is quite likely. The presence of these natural compounds could be of some importance to the drinking water industry and the detection of these compounds in natural waters would be an important research topic. This paper will discuss the types of compounds that might be characterized as natural EDCs and suggest ways of effectively isolating and identifying these compounds. Although EDCs are normally thought of as having a negative effect on the environment and as a possible health hazard, this paper will project a positive side to these natural EDCs.

SYNTHESIS AND CHARACTERIZATION OF NEW TRANSITION METAL PHOSPHATES AND PHOSPHONATES. Zeric Hulvey, William R. Gemmill & Barbara A. Reisner, Dept. of Chem., James Madison University, Harrisonburg, VA 22807. Open framework phosphate-based materials are of great interest because of their potential applications in fields ranging from separations and molecular recognition to catalysis. In an effort to synthesize new open-framework compounds containing transition metals, several strategies have been employed. Using these strategies, two new 2-D phosphate-based framework materials have been synthesized:  $[\text{HOCH}_2\text{CH}_2\text{NH}_2][\text{Co}(\text{PO}_4)]$  and  $\text{Zn}(\text{O}_3\text{PCH}_2\text{CH}_2\text{CH}_2\text{NH}_2)\cdot\text{H}_2\text{O}$ .  $[\text{HOCH}_2\text{CH}_2\text{NH}_2][\text{Co}(\text{PO}_4)]$  crystallizes in the orthorhombic space group  $Pca2_1$  ( $a = 7.6400(15) \text{ \AA}$ ,  $b = 13.380(3) \text{ \AA}$ ,  $c = 6.7467(13) \text{ \AA}$ ). It consists of inorganic cobalt phosphate layers that are separated by protonated ethanolamine ions. These ions are hydrogen bonded to the layers in a bidentate fashion.  $\text{Zn}(\text{O}_3\text{PCH}_2\text{CH}_2\text{CH}_2\text{NH}_2)\cdot\text{H}_2\text{O}$  crystallizes in the monoclinic space group  $P2_1/c$  ( $a = 9.0895(3) \text{ \AA}$ ,  $b = 5.0005(2) \text{ \AA}$ ,  $c = 6.7467(13) \text{ \AA}$ ,  $\beta = 3.337(3)^\circ$ ). It has a unique structure for a 2-D metal phosphonate; it contains a hybrid organic-inorganic layer. The layers contain 1-D  $\text{Zn}_2\text{P}_2$  ladders that are connected to each other by the amino end of the phosphonate group. The layers are held together framework water that is hydrogen bound to the layers.

A SYNTHETIC APPROACH TO 1-SUBSTITUTED  $\gamma$ -CARBOLINES. W. M. Stalick, C. A. Roberts, J. H. Wynne & S. Bosen, Department of Chemistry, George Mason University, Fairfax, VA 22030-4444. Despite the increasing interests in tryptamines and their carbazole derivatives, pyrido[3,4-b]indoles, very little is known about their counterparts, the corresponding [4,3-b] analogues. This is primarily due to the lack of availability of such compounds as well as the inability to selectively introduce functionalities into these derivatives. We report two novel methods for their formation. The first proceeds from a 3-bromo-1-silyl protected indole which is condensed with a variety of N-tosylaldimines. The second involves the acylation of indole followed by reductive amination; both methods afford a different variety of 3-aminomethyl derivatives. In either case subsequent intramolecular cyclization, followed by aromatization, in a one-pot process, affords the desired fully aromatic carbazole. This approach allows for control in the introduction of various substituents into the 1-position as desired.

BLACK GOO: A FUNGAL DISEASE IN GRAPEVINES. David McGinnis & Roy L. Williams, Old Dominion Univ. Enological Research Facility, Dept. of Chem./Biochem., Old Dominion Univ., Norfolk, Va. 23529. Over the past ten years many wine producing countries have described a common fungal disease that has come to be known simply as Black Goo. The source of this devastating disease is the fungus known as *Phaeoacremonium chlamyosporium*. This fungus infects the vine and causes a degradation of the vascular system and the subsequent development of a black goeey substance in the xylem of the plant. The nature and source of this Black Goo is still unknown and is of considerable importance to the wine industry. This laboratory has now been able to culture this fungus from infected vines from a Virginia vineyard and we are attempting to determine the chemical nature of the Black Goo substance that appears in the xylem. We are using various analytical methods including infrared analysis, high-pressure liquid chromatography and GC/MS to help characterize this material and to determine its origin in the plant. The nature and appearance of the Black Goo component appears to be associated with the synthesis and release of a natural antifungal phytoalexin known as trans-resveratrol.

THE DESIGN, SYNTHESIS AND EVALUATION OF NOVEL CALCIUM CHANNEL BLOCKERS IN HUMAN PLATELETS. Beth Dovel<sup>1</sup> & Roy L. Williams<sup>1</sup>, <sup>1</sup>Dept. of Chem./Biochem., Old Dominion Univ., Norfolk, Va. 23529 and Yuliya Dobryднеva<sup>2</sup> & Peter Blackmore<sup>2</sup>, <sup>2</sup>Dept. of Physiological Sciences, Eastern Virginia Medical School, Norfolk, Va. 23508. 2-Aminoethoxydiphenyl borate (2APB) has been shown to be an effective inhibitor of store-operated calcium channels (SOCC) in human platelets. This inhibition of calcium influx in human platelets is important with regards to the potential of this compound as a cardiovascular agent and the treatment of heart disease and the aggregation of platelets in the blood stream. A number of structurally related compounds have been designed based on the proposed mechanism of action of this drug and these compounds have now been synthesized and characterized in this laboratory. The scope of the synthetic approach to the design of a more effective calcium channel blocker will be discussed together with the method of synthesis and analytical features of these novel compounds. Nuclear magnetic resonance data will be presented that confirms the presence of a five membered ring in many of the simpler 2APB analogs. Structure activity relations of the various 2APB analogs will be discussed in an effort to rationalize the mechanism of action of these agents in human platelets.

THEORETICAL STUDIES OF PRECURSOR AMINES OF NOVEL ANTIMICROBIAL QUARTERNARY AMMONIUM SALTS. Juan C. Jimenez, Annick Charlotte, Sabrina M. Aponte, & Edmund Moses N. Ndidip, Dept. of Chemistry, Hampton University, Hampton, VA 23668. The focus of our study is to determine structure – property and structure – activity relationships for a new class of quaternary ammonium salts (QAS). This paper presents results presents results of conformational analysis, optimized geometries and some electronic properties of series of a number of model precursor amines. The anomeric effect is also presented. Molecular simulations (modeling) were done using semi-empirical (AM1, AM1-SM2, PM3) and Monte Carlo routines contained in

MACROMODEL. The calculations suggest that the hydrogen -- bonded structure is the preferred conformation for precursor amines, and simple QAS instead of the hemicholinium. Electrostatic potential plots have been obtained. These are to be used to determine active sites for interaction between drug molecule and a potential receptor site.

THE HYDROPATHIC ANALYSIS OF DNA INTERCALATORS TO DESIGN HIGHLY SEQUENCE-SPECIFIC COMPOUNDS. Derek J. Cashman<sup>1</sup>, Glen E. Kellogg<sup>1</sup>, & J. Neel Scarsdale<sup>2</sup>, Dept. of Med. Chem.<sup>1</sup>, Virginia Commonwealth Univ., Richmond, Va., 23219-1540., & Dept. of Biochem. & Mol. Biophysics<sup>2</sup>, Virginia Commonwealth Univ., Richmond, Va., 232191540. Molecular models of the potent anticancer compound doxorubicin, 59 analogs, and their intercalation complexes in 6 unique DNA quartet sequences were minimized using molecular mechanics techniques. The molecular modeling program HINT (Hydrophatic INTERactions) was then used to calculate quantitative binding scores of each complex. The difference in the HINT interaction scores in all six sequences was then analyzed and compared. Methods to analyze these interaction scores and compare them to the structure of the compounds will be discussed. In addition to a total HINT score for the binding of the drug with DNA, individual HINT scores can be calculated between the drug and the four individual base pairs that are in the vicinity of the intercalation site, to analyze the individual parts of the drug molecule that are contributing to selectivity. Further correlations between HINT scores and experimental  $\Delta G$  will also be presented for some compounds.

THE ROLE OF IONIZATION STATE IN HINT CALCULATIONS OF BINDING FREE ENERGY FOR INFLUENZA VIRUS NEURAMINIDASE-INHIBITOR COMPLEXES. M. Fornabaio<sup>1,2</sup>, G. E. Kellogg<sup>1</sup>, A. Mozzarelli<sup>2</sup>, P. Cozzini<sup>2</sup> & D. J. Abraham<sup>1</sup>. <sup>1</sup>Dept. of Medicinal Chemistry, Virginia Commonwealth University, Richmond, VA 23298 and <sup>2</sup>Dept. of Biochemistry and Molecular Biology, University of Parma, Italy. The prediction of binding affinity between protein and ligands is a key problem for computational biochemistry and drug discovery. HINT (Hydrophatic INTERaction) is a software model based on experimentally determined solvent partitioning data between water and 1-octanol ( $\text{LogP}_{\text{ow}}$ ) to obtain an empirical model of biomolecular association. As  $\text{LogP}_{\text{ow}}$  can be directly correlated with free energy, HINT's peculiarity is that it can evaluate not only the enthalpic contributions but also the entropic contributions to ligand binding. This software can predict, with reasonable accuracy, the free energy of ligand binding. The present work is focused on the calculation of binding free energy for Influenza Virus Neuraminidase-inhibitor complexes, highlighting the role of the ionization state of ligands and of protein active site residues (Asp or Glu) for model building. Attention is paid to the relationship between the ionization state and the pH conditions under which the binding measurements are made and the correlation between experimental free energy and HINT scores is shown.

NUCLEOPHILIC SUBSTITUTION MECHANISMS - SCRATCHING THE SURFACE. Charles M. Bump, Department of Chemistry, Hampton University, Hampton, VA 23668, The purpose of this work is to examine nucleophilic substitution reactions in order to better understand and differentiate between  $S_N1$  and  $S_N2$  type reaction mechanisms. Using the public domain release of MOPAC 6.0 ported to the PC, semi-empirical (AM1) potential energy surfaces for carbon to nucleophile distances of 10.0 to 1.5 angstroms and carbon to leaving group distances of 1.5 to 10.0 angstroms were generated for the (gas phase) reactions of n-butyl bromide, sec-butyl bromide, and tert-butyl bromide with chloride ion. In  $S_N1$  reactions, the leaving group departs while the incoming nucleophile is further away from the reaction site than it does in an  $S_N2$  reaction. There is little difference between reaction mechanisms in terms of charge associated with the incoming nucleophile, the carbon at the reaction site, and the leaving group. While there are regions of relatively high stability that are outside the reaction path, the activation energy required to assume those conformations is prohibitive.

**Computer Science**  
(No Abstracts Submitted)

**Education**

DISCOVERING WOMEN IN THE BIOLOGICAL SCIENCES: A LABORATORY COURSE FOR NON-SCIENCE MAJORS. Elsa Q. Falls, Dept. of Biol., Randolph-Macon College, Ashland, VA 23005. Traditionally, women have not been well-represented in the sciences in the United States. They have served historically as assistants to male scientist relatives, but their names and specific contributions have been largely hidden. Dating back to Charles Darwin, cultural biases have indicated that women are inferior to men. Currently, women make up over 50% of the country's workforce but only about 16% of employed scientists and engineers. Explanations for this disparity have included gender differences in intellectual abilities and differing experiences in the sciences. There continue to be barriers to women's participation in science and segregation among institutions and scientific fields. The current on-going investigation involves collection of data on non-science majors' perceptions and knowledge of contemporary and historical science and scientists. It was hypothesized that a course for non-science majors highlighting historical and contemporary women biologists and their contributions would change student attitudes toward science and scientists. A collegiate requirement laboratory course was developed and is being offered for the first time during spring semester 2002. Pre- and post-course surveys of these students, as well as students in other non-science major courses are being conducted to determine if attitudes can be changed.

DEMONSTRATING THAT HABITAT STRUCTURE FACILITATES COEXISTENCE OF PREY AND PREDATOR. Tracey R. Embrey & Timothy W. Stewart, Department of Natural Sciences, Longwood College, Farmville, VA 23909. Habitat structure, defined as physical objects in an environment that provide habitat, is important in ecosystems because it regulates organism abundance and species diversity. We designed a laboratory experiment to show students that habitat structure increases prey survivorship by providing refuges from predation. In the experiment, goldfish held in aquariums forage on two species of invertebrate prey in both the absence (no-structure treatment;  $n = 5$  replicates) and presence (structure treatment;  $n = 5$  replicates) of habitat structure created by stones and ceramic tiles. Results from two-sample  $t$  tests generally show that a significantly greater number of bottom-dwelling *Gammarus* (i.e., amphipods) survive in the structure treatment than in the no-structure treatment. In contrast, *Daphnia* are open-water organisms that do not use the structure we provide to them, and *Daphnia* survivorship in the two treatments does not differ. Results demonstrate that by creating refuges, habitat structure increases the likelihood of predator-prey coexistence. Additionally, diverse forms of habitat structure are required to provide refuges for multiple prey species, and to maintain high species diversity in ecosystems.

GAUGING SCIENCE LITERACY THROUGH THE ANALYSIS OF STUDENT WRITING: RUBRIC DEVELOPMENT USING UNDERGRADUATE NON-SCIENCE MAJORS. Woody McKenzie & Clancy Leahy, Lynchburg College, Lynchburg, VA 24501. A rubric of student writing to rate attributes that define science literacy was developed using primary trait analysis. In this pilot study, one evaluator rated graded written exams. Students chose from four different current topics (threat of biowarfare, alternative fuels legislation, mammograms for detection of breast cancer, and genetic engineering as a cure for diabetes). Each topic included a set of specific prompt questions to guide students. The rubric used Likert type rankings to assess the student's ability in: 1.) posing the question, 2.) research acquisition, 3.) research evaluation, and 4.) use of research. Of twenty-nine papers evaluated, four were rated expert. Eleven showed serious inadequacies in ability to research and make well-reasoned decisions on complex issues requiring information gathering and filtering in the scientific realm. In general, students were able to ask relevant questions, but relied heavily upon internet sources for evidence. In many cases, some "evidence" did not directly relate to the question

posed. Interestingly, students researching biowarfare displayed the lowest level of science literacy. More examples of student writing need to be evaluated. More evaluators need to rate these to establish inter-rater reliability. More piloting needs to be done with students receiving fewer prompts

FIRST YEAR STUDENTS' SATISFACTION WITH COLLEGE AND SENSE OF BELONGING: A COMPARISON OF LEARNING COMMUNITY AND NON-LEARNING COMMUNITY STUDENTS. Jennifer Ann Morrow, J. Worth Pickering, & Sandra M. Waters, Old Dominion University, Norfolk, VA 23529. Old Dominion University began offering Learning Communities in the Fall of 1996 as a way to address the increasing problems of students in academic difficulty and attrition rates. Learning Communities at ODU are made up of a cohort of approximately 25 students who are enrolled in three linked general education courses. Early research on Learning Communities at ODU, showed that Learning Community students had more positive relations with faculty members and fellow students. Learning Communities also showed a positive impact on academic difficulty, academic success, and retention rates. In the Fall of 2001, Learning Community students reported significantly higher levels of seeing connections between their classes, making friends in classes, and intention to return for their sophomore year. Learning Community students also reported significantly higher levels of perceived peer support and significantly lower levels of perceived isolation. Next Fall, approximately 50% of entering First Year students will be enrolled in either Curricular or Residential Learning Communities.

DISCOVERING SCIENCE THROUGH MICROBIOLOGY: BIOLOGY MAJORS, NON-SCIENCE STUDENTS, AND HIGH SCHOOL STUDENTS. D. L. Wohl<sup>1</sup>, P. B. Lessem<sup>1</sup>, & J. B. Reed<sup>2</sup>, University of Richmond, Richmond, VA 23173 and <sup>2</sup>the Greater Richmond Area Higher Education Consortium (GRAHEC), 4901 Fitzhugh Ave. Suite 301, Richmond, VA 23230. We are offering experiential learning opportunities to three different populations of students including University of Richmond undergraduates (biology and non-science students) and high school students enrolled in GRAHEC programs. To maximize student learning and efficiency in presentation, we have developed one general course design that can be delivered to our three targeted populations. Both the non-science student's course (*Unseen Life*) and the biology major's course (*Microbiology*) will be offered in the spring semester resulting in similar preparations. Similar in design and subject, *Microbes: Life's Small Beginnings (Microbes)* can then be offered that summer to high school students. All three courses will use microbes isolated from area waters for further analysis. Investigations will focus on antibiotic resistance in environmental isolates. This project is supported by the NSF division of Undergraduate Education : Course, Curriculum and Laboratory Investigation.

### Environmental Science

CHARACTERIZATION OF *Pseudomonas fluorescens* STRAIN 29L AND DEGRADATION OF PYRENE AS SOLE CARBON AND ENERGY SOURCE. R. J. Ganguli, J. Otte & C. D. Litchfield, Dept. of Environmental Science & Policy, George Mason Univ., Manassas, VA. A pyrene degrading bacterium, isolated from a creosote-contaminated site, using Bushnell-Haas medium supplemented with 0.3 gm/L medium each of naphthalene, phenanthrene, and pyrene. It was identified as *Pseudomonas fluorescens* Strain 29L by BIOLOG™ and further confirmed by 16S rDNA analysis. Strain 29L was able to grow in a medium containing NH<sub>4</sub>Cl as the nitrogen source supplemented with 0.001% yeast extract and up to 300mg/L pyrene as the sole source of carbon and energy. CO<sub>2</sub> respirometric studies using biometer flasks revealed that nearly 20% of the 50mg/L pyrene added was respired as CO<sub>2</sub>. Phenanthrene, anthracene, chrysene, salicylic acid, and phthalic acid also support the growth of this bacterium. Mineralization of <sup>14</sup>C-labeled pyrene to <sup>14</sup>CO<sub>2</sub> indicated that pyrene did serve as sole carbon and energy source. Strain 29L was subjected to various curing agents to determine whether this pyrene-degrading capability is plasmid-borne. Pyrene is one of the priority

pollutants listed by USEPA. Studies on pyrene degradation will help in devising better technologies for the biodestruction of such hazardous chemicals.

**METAMORPHOSIS-DEPENDANT LEAD SENSITIVITY IN AMERICAN BULLFROG LARVAE.** James A. Wise, Dept. of Biol. Sci., Hampton Univ, Hampton, Va 23668. Lead toxicity is still a major health problem in the U.S., especially in children. Children exposed to low lead levels show a variety of developmental defects. In spite of these data, the lowest level of lead exposure that a child can safely be exposed to has not yet been established. Our laboratory has developed an American Bullfrog (*Rana catesbeiana*) larval model to investigate the effects of chronic, low level lead exposure on their physiology. These data from this developmental amphibian model will be used to develop a risk assessment model for low-level lead exposure in developing human beings. Initial studies showed differential sensitivity ( $LC_{50}$ ) of the larvae to high-level lead exposure in a 24 hr, Acute Toxicity Test (ATT) according to developmental stage. In this study, we developed a 7-day, Chronic Toxicity Test (CTT) to more accurately model environmental lead exposure. We found that tadpoles exposed to lead in the CTT were likewise differentially sensitive according to developmental stage, and that the larvae in this test were sensitive to levels of lead ( $>10$  ppm) an order of magnitude lower than that seen in the ATT. These levels are in the range of the lowest acceptable lead exposure are recommended for human being (approximately 10 ppm). Thus, the CTT model will serve as a springboard for further investigations into the effects of lead exposure on developmental physiological processes.

**USE OF PULSED-FIELD GEL ELECTROPHORESIS FOR TYPING FECAL CONTAMINATION IN RECREATION WATERS.** Matthew R. Ettinger<sup>1,2</sup> & Denise A. Pettit<sup>1,2</sup>, <sup>1</sup>Department of Microbiology and Immunology, Virginia Commonwealth University, Richmond, VA 23298 and <sup>2</sup>Division of Consolidated Laboratory Services, Richmond, VA 23219. The introduction of fecal bacteria into environmental waters can increase the incidence of infectious diseases in populations recreating in contaminated areas. Polluted watersheds are identified using standard environmental microbiological techniques to quantitate a variety of indicator organisms, including *Escherichia coli* (*E. coli*). Restoration plans designed to bring impaired waters back into compliance require the identification of point and nonpoint sources of fecal pollution in the watershed. This process is often hampered by difficulties in correctly identifying nonpoint sources of pollution. To facilitate the identification of nonpoint sources of contamination, the molecular typing technology of Pulsed-Field Gel Electrophoresis (PFGE) has been employed. Isolates of 820 *E. coli* derived from the fecal material of 28 different source groups were lysed and DNA was digested with Xba I. DNA fragments were separated using PFGE and banding patterns were analyzed using Jaccard and Dice analysis. Isolates obtained from individual animals of the same species did not cluster. Therefore, new approaches to the analysis of the banding patterns are currently being investigated to determine if PFGE is a viable means of identifying nonpoint source pollution in recreational waters.

**FEEDING BEHAVIORS OF BOTTLENOSE DOLPHINS IN THE ELIZABETH RIVER, VA.** L. Stepp, K. Foss, and J. Reed, Dept. of Biology, Chemistry, and Environmental Science, Christopher Newport University, Newport News, VA 2360. The purpose of this study is to describe the utilization of the Elizabeth River by bottlenose dolphins. The Elizabeth River, a tributary of the Chesapeake Bay, has been characterized as the third most polluted river on the east coast. In this paper, I describe the feeding behaviors of bottlenose dolphins. Dolphins are generalist feeders and capture a variety of prey ranging from fish to squid. During 2001, a total of 59 cruises, lasting an average of three hours, were conducted from January to October. Dolphins were encountered on 28 occasions. Group sizes ranged from one adult to 80 adults. Dolphins were observed engaging in probable feeding activities during 18 encounters. During periods of probable feeding, dolphins were observed moving closer to shore. Indicators of probable feeding were a strong fish smell in the immediate area, deep diving, and birds feeding in the immediate area. Probable feeding behavior was also indicated by fish swirls and bouts of fish tossing. On several occasions, groups that were spread

out were observed moving closer together, then spreading out again. These encounters were said to include bouts of probable feeding activity since a strong fish smell was present. Fish were detected on the sounder. A pattern of probable feeding activity with respect to time of day was seen. Activity increased during the morning and decreased during the afternoon. Probable feeding activity appeared to increase with water temperature. Sampling in areas of probable feeding activity indicated that spot and croaker were potential prey.

BASELINE WATER QUALITY STUDY OF ENGLAND RUN AND AN UNNAMED TRIBUTARY TO THE RAPPAHANNOCK RIVER. Emma B. Law<sup>1</sup>, M.L. Bass<sup>1</sup> & M.L. Daniel<sup>2</sup>, <sup>1</sup>Dept of Environmental Science & Geology, Mary Washington College, Fredericksburg, VA 22401 and <sup>2</sup>OWML of Dept of Civil & Environmental Engineering of Virginia Tech, Blacksburg, VA. Surface water quality is influential and must receive consideration as human development continues to encroach upon our natural waterways. Celebrate Virginia is a proposed 1,500 acre development for Stafford County, Virginia. The development will directly impact England Run and an Unnamed Tributary. This study examined physiochemical measures monthly from November 2000 to December 2001 at seven strategic stations using EPA approved methods. Depth, flow rate, water temperature, pH, dissolved oxygen, biochemical oxygen demand, conductivity, total alkalinity, total hardness, total phosphorous, total nitrogen, total dissolved solids, and total and fecal coliforms were monitored and used to characterize the tributaries' current water quality prior to construction. Continued monitoring will allow impacts of Celebrate Virginia to be quantitatively identified. Currently, England Run and the Unnamed Tributary appear to be typical Piedmont streams with all parameters in an expected range except for coliform counts, which were elevated.

THE SIGNATURE OF GLOBAL WARMING IN THE CHESAPEAKE BAY, VA. T.C. Mosca III, Rappahannock Community College & W. Coles, Govt. of the Virgin Islands. Water temperature data collected at Virginia Institute of Marine Science at Gloucester Point, Va. from 1954 until the present were analyzed for trend. Water temperature is a sum of many functions, some periodic and some not. By collapsing the data to annual summer and winter means, the long-term trend was exposed. The trend was established to exist in the entire Virginia portion of the Chesapeake Bay, by regression against similar means of data collected by the VIMS trawl survey. The long-term trend indicates increasing temperatures, with a recorded change of 1.5 °C over the period of record. An interesting spatial/temporal pattern was also noted.

OBSERVATIONS ON THE OCCURRENCE OF *CLADOSPORIUM*, *PENICILLIUM* AND *STACHYBOTRYS* SPECIES IN AN INDOOR ENVIRONMENT, EXHIBITING PREFERENCES TO DIFFERENT BUILDING MATERIALS. Bharati Lakshmi, Environmental Testing and Monitoring Services, 2425 Bowland Parkway, Virginia Beach, VA 23454. Molds occur indoors due to moist building materials like insulation, paper and wood causing health problems like allergy, infection, irritation and toxicity at high concentrations. During renovation of an abandoned school building extensive mold growth was observed on stairwells and walls. Studies were conducted to identify the building materials affected by mold and analyze the materials for mold identification (genus level) and concentration (Colony Forming Units per gram (CFU/g)). Large quantities of mold spores were observed on textured plaster ceiling, cinderblock wall, two-coat plaster wall and gypsum and paper ceiling. *Cladosporium sp.* (2000 - 200,000 CFU/g) was identified on all the four building materials. However, *Penicillium sp.* (3000 - 50,000 CFU/g) occurred on all except textured plaster ceiling and *Stachybotrys sp.* (3000 - 60,000 CFU/g) occurred exclusively on gypsum and paper ceiling. *Stachybotrys* exhibited very high preference for gypsum and paper based material. *Penicillium* showed medium preference and *Cladosporium* exhibited least preference.

RELATIONSHIP OF FLUORIDES TO STRENGTH MEASUREMENTS IN MULE DEER ANTLERS. Mary T. Lovegreen, P. F. Scanlon, & J. H. Wilson. Depts. of Fisheries and Wildlife Sciences and Biological Systems Engineering, Virginia Tech, Blacksburg, VA 24061-0321. As "hard" tissues, deer antlers have been found to share many characteristics with bones and teeth in humans. Antlers represent a deciduous source of a substitute for bones and teeth in studies of the latter two tissues. Broken antlers have been found on deer in areas with high concentrations of natural fluoride. This project endeavored to relate concentrations of fluorides to a strength measurement of antlers of mule deer (*Odocoileus hemionus*). Antlers from two sources were available for the project: Intact antlers on hunter-killed or road-killed mule deer from Colorado Springs area, CO, and shed antlers from mule deer from Pinyon Canyon, CO. Antler sections of 2.5cm length were sawed from antler tines and the cross-sectional area of each was measured. The segments were subjected to a strength test (compression to failure) using an MTS machine. The test generated a parameter 'peak load' which when divided by cross-sectional area gave a parameter 'peak stress'. Fluoride concentrations in solutions of antler tissues were measured with an Orion portable Ion Specific Electrode attached to a pH meter with millivolt reading capabilities. Peak stress was plotted against fluoride and regressions were run. Fluoride concentrations were higher in antlers of deer from the Colorado Springs area than in deer from the Pinyon Canyon area. Measurements of antler strength were somewhat variable and regressions of strength measurements on fluoride concentrations were not particularly illustrative in determining relationships between the two variables. Fluoride seems to influence antler strength in different ways at different concentrations. Initially, fluoride tends to increase antler strength, but at higher concentrations tends to increase brittleness.

AVAILABILITY OF DEN TREES FOR BLACK BEARS IN FORESTS WITH DIFFERENT MANAGEMENT STRATEGIES. Gyasi A. Quince, P.F. Scanlon & M. R. Vaughan, Dept. Fisheries and Wildlife Sciences, Virginia Tech., Blacksburg, VA 24061-0321. Availability of den trees is of great importance to hibernation by black bears, *Ursus americanus*, in the Appalachian Mountains. This report compares availability of den trees on National Forest lands and on industrial forests of Westvaco Corporation in Virginia and West Virginia. Five study areas were chosen: 3 National Forest (2 in Virginia and 1 in West Virginia) and 2 industrial forest sites (1 each in Virginia and West Virginia). Within each of the 5 locations stands with ages within the ranges < 50 years post-harvest, 51 to 100 years post-harvest, and 100+ years post-harvest were chosen. Five quadrats, each 40m x 40m were randomly selected within each age-group for detailed examination of the presence of den trees. Potential den trees, specifically those of DBH 75cm or greater, were recorded and tested for soundness. Unsound trees were considered to have cavities and these were checked to evaluate the quality of the cavity. Those cavities with entries equal to or larger than 43cm high and 24cm wide were considered suitable for denning. There were no 100+ years stands on the Virginia Westvaco site so only 70 quadrats were available for sampling. Potential den trees were more common in 50-100 and 100+ quadrats. Unsound trees were relatively few (total =27). Chi-square analyses indicated that the proportion of potential den trees was independent of location (VA vs. WV) and of forest management style (Westvaco vs. National Forest). Den trees were too few to draw meaningful conclusions. We appreciate support from, Westvaco Corporation, Virginia Tech, Dept. Fisheries and Wildlife Sciences and the MAOP Program, Virginia Department of Game and Inland Fisheries, U. S. Forest Service, and USGS-Biological Resources Division.

ACCEPTABILITY OF CLAY TARGET FRAGMENTS AS GRIT BY CAPTIVE JAPANESE QUAIL. Gabriela R. Gonzalez, P. F. Scanlon, K. E. Webb, Jr., M. R. Vaughan, & J. R. Craig. Depts. Fisheries and Wildlife Sciences, Animal and Poultry Sciences, and Geological Sciences Virginia Tech, Blacksburg, VA 24061. Lead toxicosis in wildlife on shooting ranges has had considerable study. However, less is known on the use by, and effect of, clay targets on local and migratory wildlife, particularly avian species. Clay targets, used for shooting practice, are composed of "clay" (dolomitic limestone) and petroleum pitch, depending on the actual target brand. Bound within the pitch are polycyclic aromatic hydrocarbons (Baer et al. *Ecotoxicology* 4:385, 1995). In this study, 36 Japanese



quail (*Coturnix coturnix japonica*) were individually confined in 50 x 30 x 23 cm cages and offered crushed samples of clay targets and/or ground limestone as grit. The objective was to determine if the birds chose the target material as grit. The quail were fed a commercial birdseed diet ad libitum. Crushed targets (size range: 1.19 to 3.36mm) and limestone, of a comparable range of sizes, were offered in separate cups. Targets of two brands, Remington Blue Rock and Federal White Flyer, were offered, resulting in two colors, orange and yellow being available as options offered. Fragments with color were separated from basic black fragments. Each treatment consisted of four birds, two males and two females. Of the 32 quail offered targets, 19 consumed some of the target materials. However, of the 12 birds offered a limestone vs. target choice, 11 birds preferred limestone to the target. This experiment was preliminary and results warrant further investigation of the acceptability and effect of clay targets on birds. [Supported by the John Lee Pratt Animal Nutrition Foundation at Virginia Tech].

CHARACTERISTICS OF SPENT LEAD SHOT AND PARTICLES AT A SHOTGUN RANGE. James R. Craig<sup>1</sup>, David Edwards<sup>1</sup>, J. Donald Rimstidt<sup>1</sup>, Patrick F. Scanlon<sup>2</sup>, Thomas K. Collins<sup>3</sup>, Oliver Schabenberger<sup>4</sup>, & Jeffrey B. Birch<sup>4</sup>. 1) Geological Sciences, (2) Fisheries and Wildlife Sciences, and (4) Statistics, Virginia Tech, Blacksburg VA and (3) US Forest Service, Roanoke, VA. Systematic studies of spent lead shot and related metals at the public recreational shotgun range in the Jefferson National Forest just west of Blacksburg, VA have revealed that the areas impacted by shooting are much greater than the 0.7 acres cleared for the range and that the distribution of the lead is non-uniform. Shooting is either at stationary or airborne targets. Stationary target shooting concentrates lead at 25-30m from the shooting box where targets of considerable variety are set. The slight incline of the range and nearly horizontal trajectory of fire concentrates the lead in the central area over a relatively short range of distances. In contrast, when shooting at air-borne targets shotguns are fired at elevated angles and most of the lead pellets carry much greater distances. This study found a peak of lead concentration at 80-100m from the shooting box and a gradual decrease in concentration out to 300m. The size of lead particles dispersed on the shotgun range vary widely because of (1) the differences in shot sizes used and (2) abrasion of lead to form small grains and shards. Most shot falling to the ground retain nearly spherical shapes and are in the range 2-3mm. However, the discharge of shot from the shotgun barrel results in the generation and dispersal of fine particulate lead in areas close to the shooting box. In addition, the impact of lead pellets with targets and the ground at short distances also results in the abrasion of pellets and the release of fine lead particles in the range at 25-30m. The release of large quantities of fine particulate lead increases potential reactivity of lead in the environment and would make the recovery of lead more difficult.

### Geography

(No Abstracts Submitted)

### Geology

COMPLEX HYDROGEOLOGIC VARIABILITY AT SHIRLEY PLANTATION, CHARLES CITY COUNTY, VIRGINIA. G. R. Whittecar and R. B. Cole, Dept. Ocean Earth and Atmos. Sci., Old Dominion Univ., Norfolk, VA 23529. Significant changes in the thickness and permeability of Quaternary strata on fluvial and estuarine Coastal Plain terraces can occur over short lateral distances, marked by only subtle topographic signatures. A stratigraphic study done in support of a groundwater monitoring project revealed the importance of fluvial histories in limiting the extent of coarse-grained sediments beneath seemingly uniform terrace surfaces. Terraces underlain by the Pleistocene Tabb Formation are sliced by small valleys filled with fine-grained Holocene sediments that support perched water tables. These terrace surfaces may show little geomorphic expression of the filled valleys, even though the Holocene sediments may be as much as 10 meters thick. Hydraulic

heads in shallow wells placed in these valley fills respond quickly to rainfall events; deeper wells respond to seasonal changes in recharge. Additional stratigraphic variations at this study site come from eroded, partially buried remnants of older Pleistocene formations. The study area also lies over a former gravel quarry, backfilled with waste sediments from adjacent gravel operations. The permeability of mine wastes varies according to the degree of sorting inherent in the backfilling process (dumping vs. settling).

MINERALOGY, PETROGRAPHY, SCANNING ELECTRON MICROSCOPY AND BACKSCATTERED ELECTRON MICROSCOPY OF MIDDLE DEVONIAN SHALES FROM HIGHLAND COUNTY, SOUTHWESTERN VIRGINIA. P. S. Sethi, L. L. Combs & M. J. Woodard, Department of Geology, Radford Univ., VA 24142. Mineralogical analyses were conducted for a total of twenty-three samples spanning the laminated Millboro Shale and the bioturbated Needmore Shale. A total of 144 photomicrographs were obtained along with over 150 SEM and BSEM images. The Millboro Shale is characterized by parallel horizontal to parallel discontinuous stratification that is overprinted by discontinuities sub-parallel to the dominant lamination direction. SEM data show typical stepped domains and stepped card-house fabric reflecting inherent lamination at the micron level. The Needmore Shale samples show generally discontinuous original lamination with varying levels of bioturbation. SEM and BSEM data show typical disrupted clay fabric associated with micron-scale bioturbation. SEM and BSEM data also reveal differences in the morphology of the pyrite phases with the Millboro Shale samples containing fewer but larger vein structures of pyrite in comparison to the Needmore Shale. This study was funded in part by the Office of Vice-President for Academic Affairs at Radford Univ.

INVESTIGATION OF THE CONTROL OF TEMPERATURE ON MINERALOGY AND SOIL GEOCHEMISTRY OF TWO PLEISTOCENE SOIL PROFILES FROM SALTVILLE, VIRGINIA. P. S. Sethi, R. C. Whisonant, J. Surber, C. Boyd & V. Williams, Department of Geology, Radford Univ., VA 24142. Saltville, the Salt Capital of the Confederacy, produced over 200 million lbs. of salt during the Civil War. This study investigated the variations in soil color in close proximity to two of the iron furnaces used for the salt making operation. Soils just below the excavated furnace sites are deep red in color in contrast to the medium yellowish soil farther away from the furnaces. Detailed mineralogical and geochemical analyses indicated that the color variation is a result of a progressive change in the oxidation state of iron (ferrous to ferric ratio) caused by heat radiating from the furnaces. Laboratory experiments involving gradually heating the native yellow soil in a ceramic kiln under controlled climate conditions were successful in replicating such a heat effect on the oxidation state of iron. Changes observed in color of samples were very similar to those at the two archaeological sites in Saltville and lend support to the 'contact metamorphic' baking history of the underlying soils. This study was funded by a NASA grant to RCW (Contract # 961517).

### Materials Science (No Abstracts Submitted)

### Medical Science

THE ANTINOCICEPTIVE EFFECT OF THC INVOLVES MODULATION OF ENDOGENOUS OPIOIDS. Melinda L. Cox & Sandra P. Welch, Dept. of Pharmacology, VCU, Richmond, Va 23298. Several lines of evidence have demonstrated interactions between cannabinoids and opioids. We addressed the hypothesis that THC-induced release of endogenous opioids results in antinociception in arthritic and normal (NA) rats. Using the Freund's Adjuvant-Induced Arthritis (FAA) test, male Sprague-Dawley rats were rendered arthritic in 19 days. THC (i.p.) and

morphine(s.c.) were found to be equally potent in both groups in the paw pressure test of antinociception. Morphine-induced antinociception, attenuated by naloxone in NA and FAA rats, was mediated by the mu opioid receptor. THC-induced antinociception, attenuated by SR141716A and naloxone in both groups, had a CB1 and opioid receptor component. A kappa opioid component was suggested by the attenuation with nor-BNI in FAA rats only. 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 which tended to have higher levels after vehicle treatment. Dyn A interaction with the NMDA receptor may contribute to hyperalgesia in the FAA rat, and THC may induce antinociception by decreasing dyn A release. Thus, the interaction of dyn A with the kappa opioid receptor predominates, resulting in antinociception.

A COMPARISON OF THE BINDING OF THREE SERIES OF NICOTINIC LIGANDS. M.Lee<sup>1</sup>, M.Dukat<sup>1</sup>, L.Liao<sup>1</sup>, D. Flammia<sup>1</sup>, M. I. Damaj<sup>2</sup>, B. Martin<sup>2</sup> and R.A.Glennon<sup>1</sup>, <sup>1</sup>Department of Medicinal chemistry and <sup>2</sup>Department of Pharmacology and Toxicology, Virginia commonwealth University, Richmond, VA 23298. A total of 24 aryl-substituted analogs of nicotine and two related series of nicotinic ligands: aminomethylpyridines and ether analogs, were examined to determine if they bind at  $\alpha_4\beta_2$  nACh receptors in a common manner. A modest correlation ( $r=0.794$ ) was found between the affinities of the nicotine analogs and aminomethylpyridines, but little correlation ( $r = 0.117$ ) was found with ether analogs. However, a modest correlation ( $r = 0.783$ ) exists between the binding of aminomethylpyridines and ether analogs. It seems that the nicotine series and ether series compounds bind differently but that the aminopyridine series compounds share some intermediate binding similarity with both.

FE AND MN COMPETITION FOR *BACTEROIDES* APOSUPEROXIDE DISMUTASE *IN VIVO*. S.J. Wise & E.M. Gregory, Department of Biochemistry, Virginia Tech, Blacksburg, VA. *Bacteroides fragilis* (ATCC 25285) synthesizes an aposuperoxide dismutase (SOD) that is active with either Fe or Mn at the active site. Under anaerobiosis, FeSOD was synthesized in anaerobic peptone-yeast-glucose medium (PYG) even with MnCl<sub>2</sub> (1 mM). Treatment of the medium with metal-chelating resin (Chelex<sup>TM</sup>) diminished the Fe content from 20  $\mu$ M to 0.5  $\mu$ M and Mn content from 1  $\mu$ M to a value below the ICP detection limit. In media thus treated (c-PYG) but supplemented with 1-10  $\mu$ M MnCl<sub>2</sub>, *Bacteroides* synthesized an increasing amount of manganese superoxide dismutase (MnSOD). Cells grown in c-PYG medium supplemented with 10  $\mu$ M Mn synthesized approximately equal amounts of Fe- and Mn-SOD. In c-PYG supplemented with 10  $\mu$ M MnCl<sub>2</sub> and 1  $\mu$ M Fe<sub>2</sub>(NH<sub>4</sub>)<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>, *B. fragilis* synthesized 80% FeSOD, 20% MnSOD. The specific activity of superoxide dismutase was comparable in each cell extract. Under conditions of stringent iron restriction *Bacteroides fragilis* may maintain cellular SOD levels by using Mn and sparing Fe for other cellular functions. (Supported in part by a research scholarship from the John Lee Pratt Animal Nutrition Program)

EFFECT OF BUPROPION AND METABOLITES IN NICOTINE-TRAINED ANIMALS. Tatiana S. Bondareva, Mikhail L. Bondarev, Richard Young & Richard A. Glennon, Department of Medicinal Chemistry, Virginia Commonwealth University, Richmond, VA 23298. Bupropion is a weakly potent stimulant used both as an antidepressant and as a smoking cessation agent. Bupropion's mechanism of action is not well understood in both cases. We used a drug discrimination method to examine the effect of bupropion and its metabolites in rats trained to discriminate the effect of 0.6 mg/kg of (-)nicotine from saline. In tests of stimulus antagonism, bupropion failed to antagonize the stimulus effects of nicotine. However, in tests of stimulus generalization, bupropion substituted for nicotine. Unlike nicotine, stimulus effects produced by bupropion are not antagonized by mecamylamine. We tested two of the major metabolites of bupropion (+)-*threo*-2-tert-butylamino-1-(3-chlorophenyl)propanol (+)-tartrate and (-)-*threo*-2-tert-butylamino-1-(3-chlorophenyl)propanol (-)-

tartrate in nicotine-trained animals. Both failed to produce nicotine-like effects. Bupropion can produce a nicotine-like effect, but does not appear to do so via either of these metabolites.

PHARMACOLOGICAL CONSEQUENCES OF ACTIVATING AND INACTIVATING MUTATIONS IN THE RAT MU OPIOID RECEPTOR. George D. Dalton & Dana E. Selley, Department of Pharmacology & Toxicology, Va. Commonwealth University, Richmond, VA. Site-directed mutagenesis of conserved residues in the G-protein coupled rat mu opioid receptor (MOR), threonine (T279K) in intracellular loop 3 and aspartate (D114N) in transmembrane domain 2, results in a receptor that is constitutively active (T279K) or less active (D114N). Upon heterologous expression of wild-type and mutant MORs in human embryonic kidney (HEK) cells, differences in G-protein activation were seen between these receptors. In T279K-MOR cells, the relative efficacy of partial agonists in activating G-proteins was increased compared to wild-type cells in [<sup>35</sup>S]GTPγS binding assays. In fact, some compounds that are normally pure antagonists displayed partial agonist activity in the T279K mutant. The opposite effect was observed in D114N-MOR cells where the efficacy of most agonists was significantly decreased. Receptor binding studies showed that the T279K-MOR was expressed at low levels compared to WT-MOR or D114N-MOR, but exhibited more dramatic receptor up-regulation following pretreatment with the MOR antagonist naloxone. These results and results obtained through immunocytochemistry suggest the T279K-MOR is constitutively down-regulated in HEK cells.

EVALUATION OF STATE-DEPENDENT LEARNING EFFECTS OF CLUB DRUGS. Katriona G. Bühler, Sharon Brown, & Jenny L. Wiley, Virginia Commonwealth University, Dept. of Pharmacology & Toxicology, Richmond, VA. State-dependent learning is a phenomenon that occurs when learning has been acquired in a chemical state and can only be recalled when under the original chemical influences. In this study, we tested ketamine, a club drug that is known on the streets as Special K. Forty rats were trained to perform an adjusting ratio task in Skinner Boxes. They were divided into 4 groups and administered 5.6mg/kg of ketamine or saline daily, fifteen minutes prior to the session. Group 1 was trained under saline with results yielding no transfer of response when rats were tested under 5.6 mg/kg ketamine. Group 2 was trained under 5.6 mg/kg ketamine and generated mixed results with slightly more than 50% of the rats passing when tested under the same drug. Group 3 trained under 5.6 mg/kg ketamine and failed to show a transfer of response when tested under saline, with all animals failing the task. Group 4 trained under saline and tested under saline, resulting in all rats meeting criteria and passing on test day which indicated an expected transfer of response. The results of this study indicate rats that were switched from ketamine to saline or from saline to ketamine failed to show a transfer of response, suggesting that state-dependent learning occurred at 5.6 mg/kg of ketamine. Supported by NIDA grant DA-01442 and an undergraduate research grant from VCU.

BINDING OF β-CARBOLINES AT SEROTONIN 5-HT<sub>2A</sub> RECEPTORS. B. Grella<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. A large series of β-carbolines, including several that are known to be hallucinogenic in humans, was synthesized and binding affinities for 5-HT<sub>2A</sub> receptors determined. The β-carbolines varied in their degree of saturation of the C-ring and by the position of a methoxy or bromo group in the A-ring. Their binding affinities ranged from 20 nM to greater than 10,000 nM depending upon the degree of saturation of the C-ring and the position of the substituent in the A-ring. It was determined that substituents at the 5-position (including some that are very large) significantly enhance binding affinity. In any event, and inconsistent with the 5-HT<sub>2A</sub> hypothesis of hallucinogenic activity, there does not appear to be a relationship between 5-HT<sub>2A</sub> binding affinity and hallucinogenic potency. A binding profile for a representative β-carboline (harmaline) showed that harmaline binds with very low affinity at most other receptor populations.

PYRROLIDINE-SUBSTITUTED BENZAMIDES AS POTENTIAL 5-HT<sub>3</sub>/D<sub>2</sub> ANTAGONISTS. E. De Oliveira<sup>1,2</sup>, M. Da Silveira<sup>2</sup>, M. Teitler<sup>3</sup> and R.A. Glennon<sup>1</sup>, <sup>1</sup>Department of Medicinal Chemistry, Virginia Commonwealth University, Richmond, VA 23298; <sup>2</sup>Faculdade de Ciências Farmacêuticas, Universidade de São Paulo, São Paulo SP, Brazil; <sup>3</sup>Albany Medical College, Albany, NY. Substituted benzamides have been used clinically as antiemetics (e.g. metoclopramide, mosapride) and antipsychotics (AP) (e.g. remoxipride, sulpiride). These effects are related either to 5-HT<sub>3</sub> and/or D<sub>2</sub> receptor antagonism. The structure-affinity relationships (SAFIR) of the aromatic portions of these molecules has been thoroughly investigated, but the pyrrolidine portion has been relatively unexplored. Hence we undertook an investigation of the structural requirements of the pyrrolidine moiety for 5-HT<sub>3</sub> and D<sub>2</sub> binding. Specifically, we examined several new 2- and 3-pyrrolidinyl-methylene-substituted-benzamides. The methodology chosen for synthesis of the substituted pyrrolidine ring, was the iodocyclization of  $\alpha$ - and  $\gamma$ -alkenyl- $\beta$ -enaminoesters. New derivatives are being synthesized to establish the SAFIR for this class of compounds. [Supported in part by a CAPES Fellowship, Brazil.]

CHRONIC DELTA-9 THC EXPOSURE DECREASES THE EFFICACY AND POTENCY OF THE NONSTEROIDAL ANTI-INFLAMMATORY DRUGS (NSAIDS). Rene Anikwue & Sandra Welch, Dept. of Pharmacology and Toxicology., Va. Commonwealth University., Richmond, Va 23298. Cannabinoids have been shown to increase the release of arachadonic acid metabolites and induce Cyclooxygenase-2 (COX-2) expression. We evaluated the antinociceptive effects of chronic administration of  $\Delta^9$  THC, anandamide (an endogenous cannabinoid) and methanandamide on several NSAIDS via p.o and/or i.p routes of administration using the mouse PPQ test, a test for visceral nociception. Our studies with the CB1 antagonist (SR141716A) and the CB2 antagonist (SR144528) were performed in order to better characterize PPQ interactions with cannabinoid receptors. When NSAIDS (p.o.) were administered the ED50's were as follows: aspirin 23 mg/kg, indomethacin 3 mg/kg, celecoxib 5 mg/kg, ketoralac 3 mg/kg, acetaminophen 57 mg/kg (32.3-99.8) and diclofenac 0.8 (0.1-4.9). In animals given chronic  $\Delta^9$  THC only diclofenac and acetaminophen were active. Conversely, chronic methanandamide (i.p.) did not alter the antinociceptive effects of the NSAIDS. Neither the CB1 or CB2 antagonist blocked the effects of the NSAIDS.

A QSAR STUDY OF ARYLGUANIDINES / 5-HT<sub>3</sub> INTERACTIONS. M.Khalifa<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>Center for Neuropharmacology and Neuroscience, Albany Medical College. Arylguanidines are a novel class of compounds that interact at 5-HT<sub>3</sub> receptors. Preliminary studies in our laboratories suggested the involvement of lipophilic and electronic character in their binding interactions. A statistically valid number of 3- and 4- substituted arylguanidines were synthesized and their affinities for 5-HT<sub>3</sub> receptors were measured. A correlation was found between their pKi values, lipophilic and electronic character. It was concluded that the lipophilic nature of the 4-position substituent (n = 7, r = 0.82) is more important than its electronic character (r = 0.24), whereas for 3-substituted compounds electronic character (n = 7, r = 0.88) is more important than lipophilic character (r = 0.14). Both properties seem to play a role in 5-HT<sub>3</sub> binding.

BUPRENORPHINE SUBSTITUTION IN THE TREATMENT OF MORPHINE-DEPENDENT RAT PUPS. D. C. Stoller & F. L. Smith, Department of Pharmacology/Toxicology, Virginia Commonwealth University, Richmond, Virginia. Infants receiving ECMO or mechanical ventilation require continuous infusions of morphine and exhibit signs of withdrawal upon cessation of morphine. Currently, the morphine dose is tapered over 2- to 3- weeks to avoid withdrawal. Studies on dependent adults demonstrate that buprenorphine effectively reduces opiate withdrawal. Alzet 1003D osmotic minipumps were implanted into the subcutaneous space of post-natal day 14 rats to deliver morphine at 2 mg/kg/h. After 72-h, the effectiveness of single and repeated doses of buprenorphine was assessed in rats undergoing spontaneous withdrawal. Signs of wet-dog shakes, abdominal

stretches, and forepaw tremors were counted, and signs of splayed hind limbs, ptosis, and evoked vocalization were noted as either absent or present. Vehicle-injected rats exhibited a robust spontaneous withdrawal from morphine. A single dose of buprenorphine (1 mg/kg) administered 30-min before pump removal reduced the early signs of morphine withdrawal. Repeated doses of buprenorphine suppressed withdrawal throughout the entire 5-day period. In addition to physical dependence, 72-h of continuous morphine administration result in the development of tolerance with a complete loss in the efficacy of further morphine doses.

**GAMMA-CARBOLINE BINDING AT HUMAN 5-HT<sub>5A</sub> RECEPTORS.** 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> receptors subfamily was discovered in 1992 and is still not well explored. The pharmacological and biochemical mechanisms of this receptor are still unclear due to lack of selective ligands. Several reports claimed the involvement of 5-HT<sub>5</sub> receptors in migraine, psychiatric disorders, emotional control, 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. There is 82% amino acid identity between rat, mouse and human 5-HT<sub>5A</sub> receptors. We have identified  $\gamma$ -carboline derivatives as binding m5-HT<sub>5A</sub> receptors. These ligands were modified systematically i) to improve affinity for h5-HT<sub>5A</sub> receptors, ii) to compare affinity between human and mouse 5-HT<sub>5A</sub> receptors, and iii) to identify minimal structure requirements of the  $\gamma$ -carbolines for binding at h5-HT<sub>5A</sub> receptors.

**ROLE OF ERYTHROPOIETIN-DEPENDENT AND CONSTITUTIVE PHOSPHORYLATION OF BAD ON SERINE 112 IN SURVIVAL/APOPTOSIS OF ERYTHROID CELLS.** R.M. Abutin, H. Bao, S.M. Jacobs-Helber, D.L. Barber, and S.T. Sawyer, Dept. of Pharmacology & Toxicology, VCU. Erythropoietin (EPO) is the primary hormone required for survival, proliferation, and differentiation 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 cancerous cells may activate BAD protein kinases, leading to phosphorylation and sequestration of BAD with 14.3.3 to suppress BAD activity. Whereas BAD may be phosphorylated at serine residues 112, 136, and 155, we observed phosphorylation of BAD only at serine 112 in all cells tested. Tested Apoptosis-resistant cell lines maintained a constitutive phosphorylation of BAD after extended removal of EPO compared to apoptosis-sensitive cell lines. LY294002, a PI3 kinase inhibitor, blocked constitutive BAD phosphorylation with a modest decrease in EPO-dependent phosphorylation. Also LY294002 treatment of HCD57-R cells shifted the onset of apoptosis from 24 hours following EPO withdrawal to immediately. Combinations of LY294002 and other inhibitors decreased BAD phosphorylation to nearly undetectable levels but did not induce apoptosis in HCD57-R cells in the presence of EPO. In contrast to a role of constitutive BAD phosphorylation in limited survival of leukemia cells deprived of EPO, activation of BAD S112 kinase activity is not required for long term survival when EPO is present.

**SAR OF TRYPTAMINE BINDING AT 5-HT<sub>6</sub> RECEPTORS.** M.R.Pullagurta<sup>1</sup>, J.B.Rangisetty<sup>1</sup>, B.L.Roth<sup>2</sup>, M.Dukat<sup>1</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. 5-HT<sub>6</sub> receptors belong to the family of GPCRs and are positively coupled to an adenylate cyclase second messenger system. 5-HT<sub>6</sub> receptors are believed to play a role in locomotor control, cognition and memory processes and seizure propagation. 5-HT<sub>6</sub> receptor antagonists might be useful in the treatment of several CNS disorders, memory and cognitive dysfunction, and as anticonvulsants. We earlier reported our discovery of the novel 5-HT<sub>6</sub> receptor antagonists, N<sub>1</sub>-(benzenesulfonyl)tryptamines. In the present investigation, structure activity studies were conducted to determine the influence of individual structural features of the N<sub>1</sub>-(benzenesulfonyl)tryptamines that are required for high-affinity binding. Several novel structure-types were identified that retain high affinity for 5-HT<sub>6</sub> receptors.

INVOLVEMENT OF PKC AND PKA IN MORPHINE TOLERANCE BUT NOT PHYSICAL DEPENDENCE IN MICE. R.R. Javed, F.L. Smith, M.J. Elzey, S.P. Welch, D. Selley, L. Sim-Selley & W.L. Dewey, Department of Pharmacology and Toxicology, Virginia Commonwealth University School of Medicine, Richmond, Virginia 23298. Evidence shows that the phosphatidylinositol cascade plays an important role in the expression of opioid antinociceptive tolerance. Previous studies from our laboratory demonstrated that PKC inhibitors acutely reversed a 8-fold level of morphine tolerance when injected intracerebroventricularly 30-min before the radiant heat tail-flick test. Experiments in this study attempted to determine the duration of tolerance reversal by two structurally dissimilar PKC inhibitors, Go 7874 and sangivamycin. We found that these inhibitors persistently reversed morphine tolerance for up to 24-h. However, these inhibitors failed to block naloxone-precipitated withdrawal. Other studies have shown that the PKA inhibitor, KT-5720, completely reversed 8-fold morphine tolerance. This led us to conclude that both PKC and PKA mediate morphine antinociceptive tolerance. We speculated that the individual contribution of both protein kinases to tolerance would be revealed in mice with profound morphine tolerance. We found that combined administration of both PKC and PKA inhibitors completely reversed a 50-fold morphine tolerance.

REAL-TIME-RT-PCR ANALYSIS OF RANK-L AND OPG EXPRESSION IN CULTURED FIBROBLAST AND MACROPHAGE CELLS: IMPLICATIONS FOR OSTEOLYSIS. M. Li<sup>1</sup>, J. Greenhalgh<sup>2</sup>, W. A. Jiranek<sup>3</sup> & M. J. Beckman<sup>2</sup>, Depts. of <sup>1</sup>Anatomy and <sup>2</sup>Biochemistry, <sup>3</sup>Orthopaedic Surgery and Orthopedic Research Lab, Virginia Commonwealth University, Richmond, Va 23298. Fibroblasts and macrophages have been found to be the main cell types in the periprosthetic membrane. In vitro studies have demonstrated OPG and RANK-L protein expression in the membrane using immunohistochemistry. In this study, quantitative gene expressions of OPG and RANK-L were stimulated by the IL-1 $\beta$  and TNF- $\alpha$  added into culture with U-937 (macrophage) or HS-5 cells (fibroblast).  $1 \times 10^6$  cells were incubated with IL-1 $\beta$  (50ng/ml) or TNF- $\alpha$  (50ng/ml) at various time points for 0,1,3,6,9 and 18 hrs. Real-time RT-PCR was developed to quantify the amount of RANK-L and OPG mRNA in each sample. We found RANK-L gene expression in both cell types is extremely low. OPG gene expression was higher in HS-5 than in U-937, but present in both cell types. The highest level of OPG gene expression was in HS-5 cells around 6 hr after treatment with either IL-1 $\beta$  (4-fold) or TNF- $\alpha$  (2-fold). While in U-937 cells, the OPG gene expression increased only slightly during the 1 and 3 hr for IL-1 $\beta$  and TNF- $\alpha$  treatments, respectively.

CHROMIUM SUPPLEMENTATION IN INSULIN-DEPENDENT DIABETES MELLITUS RATS. M. J. Fell & K. E. Loesser, Dept. of Biol., Mary Washington College, Fredericksburg, VA 22401. Chromium has been shown to decrease blood glucose levels of IDDM animals, potentiate the insulin activity by 10-fold or more at low levels *in vitro*, and increase the sensitivity of insulin receptors. The purpose of this experiment was to investigate the possible benefits of chromium supplementation in IDDM rats. It was hypothesized that rats placed on insulin and a chromium diet would have greater tyrosine kinase activity due to an increased amount of insulin receptors, a lower concentration of cholesterol, a higher body weight ratio (death vs. start), and a higher muscle to body weight ratio when compared to the nonchromium-supplemented IDDM rats. Chromium was given to 2 groups of IDDM rats. Each group of rats was kept for 1 month and either supplemented with  $1 \mu\text{g CrCl}_3 \cdot 6\text{H}_2\text{O} + \text{insulin}$  (n=5), insulin alone (n=4), or unsupplemented (n=6). It was determined that the IDDM rats placed on the chromium supplemented diet did not differ in any parameter, except in the muscle to body weight ratio, from other groups. The IDDM rats supplemented with insulin and chromium had a smaller gastrocnemius muscle to body weight ratio when compared to the other IDDM group. These results infer that a chromium diet does not alleviate the symptoms/conditions of IDDM.

EFFICACY OF  $\gamma$ -TOCOPHEROL VS.  $\alpha$ -TOCOPHEROL TO AMELIORATE ATHEROSCLEROTIC PLAQUE FORMATION. Sara E. Woodie & K. Loesser-Casey, Dept. of Biol., Mary Washington College, Fredericksburg, VA 22401. Atherosclerosis is one of the leading causes of death in our country. Previously, many patients were treated with the alpha form of Vitamin E to ameliorate the plaque development that lead to this disease. However, recent studies suggest this was an ineffective treatment. We hypothesized that  $\gamma$ -tocopherol would serve as a more effective preventative measure than  $\alpha$ -tocopherol because  $\gamma$ - is preferentially absorbed over  $\alpha$  and it is found in greater quantities in our natural food supply. Therefore 16 male hyperlipidemic mice (JAX strain C57BL/6J) were randomly assigned to 1 of 4 groups each fed a different diet: 1) regular chow, 2) high fat chow, 3) high fat chow supplemented with  $\alpha$ -tocopherol, and 4) high fat chow supplemented with  $\gamma$ -tocopherol. Serum lipid levels, plaque development, and weight gains were measured after the 16 weeks. Alpha-treated mice showed a small, but statistically insignificant increase in body weight in comparison with  $\gamma$ -treated mice. The serum HDL levels of  $\alpha$ -tocopherol treated mice were significantly lower (mean 28.4 mg/dL) than any other group, but no other lipid levels were statistically different. We conclude that  $\gamma$ - may be more useful than  $\alpha$ - tocopherol for increasing HDL levels.

EXPERIMENTAL MYASTHENIA GRAVIS. E. R. Printy & K E. Loesser, Dept. of Biol., Mary Washington College, Fredericksburg, VA 22401. Myasthenia gravis (MG) is a chronic autoimmune disease that affects about 14 out of 100,000 people in the U.S. In MG, auto-antibodies are produced that block, alter or destroy the acetylcholine receptors essential for muscle contraction. The specific goal for this project was to develop and characterize an animal model for the study of MG. Twelve C57BL-6 mice were immunized for the experiment, 6 with 2 injections of complete Freund's adjuvant (CFA) 25 days apart and 6 with bp129-145 of the  $\alpha 1$  subunit of the acetylcholine receptor (Bachem Pharm.) emulsified in CFA. Twenty-five days later, the gastrocnemius muscle was evaluated for muscle strength and fatigue. The isometric tension developed was measured by attaching the Achilles tendon of the mouse to a F-200 Myograph force transducer integrated to DigiMed analyzers and a computer. The muscle was externally stimulated via the sciatic nerve using 50 volt stimuli at various frequencies. It was determined that both groups of mice reacted equally well to a single stimulus but the mice with MG fatigued much faster under continuous stimulation. This experimental myasthenia gravis model is thus representative of human MG in which daily repetitive action of voluntary muscles causes weakness and fatigue quicker than normal.

### Natural History & Biodiversity

MICROHABITAT DIFFERENCES BETWEEN THE ANTS *MONOMORIUM MINIMUM* AND *M. VIRIDE* (FORMICIDAE: MYRMICINAE) IN A LONGLEAF PINE FOREST. Hannah C. Revis & Deborah A. Waller, Department of Biology, Old Dominion University, Norfolk, Va 23529. The ant *Monomorium minimum* Buckley occurs widely throughout the United States in a variety of soil types. A close congener, *Monomorium viride* Brown, is restricted to sandy soils along the East Coast. Prior to this study, *M. viride* was recorded from Florida, North Carolina and New Jersey. We collected both *M. minimum* and *M. viride* in Virginia in the Blackwater Ecological Preserve in Isle of Wight County by using pitfall traps and ant baits along two 20 m transects set 50 m apart in two sites. *Monomorium viride* was collected in Site A, an open dirt road, and *M. minimum* was collected in Site B, a woodland trail. Habitat data, including soil and vegetation characteristics and canopy cover, were examined along the transects. Five soil classes were measured; the two smallest classes were significantly different between the sites. Vegetation species composition also differed significantly between the sites, but the species diversity indices were not significantly different. Percent canopy cover was significantly greater over Site B where *M. minimum* was found. Future research will focus on whether these habitat differences are of biological importance to the ants.



A DEMOGRAPHIC ANALYSIS OF THE SNAIL *LEPTOXIS CARINATA* IN AN APPOMATTOX RIVER TRIBUTARY: MOVEMENT PATTERNS VARY AS A FUNCTION OF HABITAT TYPE. Lori M. Brantley, Tim Stewart & Tiffany R. Edwards, Department of Natural Sciences, Longwood College, Farmville, VA 23905. An ecological study of a common river snail, *Leptoxis carinata*, was conducted from August 2001 to November 2001. One hundred snails were collected from two different sites (slow run, riffle) within Fishpond Creek, a tributary of the Appomattox River, Virginia. Snails were marked with bee tags and returned to the site of capture. Over a 28-day period, marked snails were tracked to evaluate substratum preference, and movement direction and distance as a function of habitat type. From a previous study we determined that these snails prefer large substrata, such as boulders and cobble, that have large surface areas for algal growth (their main food source) and that also provide refuges in the event of heavy flooding and strong currents. Consistent with hypotheses, snails inhabiting the slow run site, which was dominated by gravel, sand and silt substrata, demonstrated significant upstream movement as they likely searched for higher quality habitat. In contrast, negligible movements occurred among snails at the riffle site that already occupied good habitat.

COLONY DISTRIBUTION OF THE FUNGUS-GROWING ANT *TRACHYMYRMEX SEPTENTRIONALIS* RELATED TO LIGHT AVAILABILITY IN A LONGLEAF PINE HABITAT. Jonathan P. Howell & Deborah A. Waller, Biology Department, Old Dominion University, Norfolk, VA 23529. *Trachymyrmex septentrionalis* represents the only species of fungus-growing ant in the southeastern United States. These ants are common in Florida, but increasingly scarce as they near the northern extent of their range in New Jersey. This study was performed in the Blackwater Ecological Preserve where approximately 160 active nests have been monitored since April 27, 2001. Colonies were seasonally active for 13 weeks, from April 27 to October 12. Data from three geographically distinct populations were analyzed for this study. Population densities ranged from 0.102 to 0.134 nests/m<sup>2</sup> and were significantly affected by ground cover. Further analysis of ground cover found a significant relationship between cover and soil and air temperature and humidity. Previous research has demonstrated that soil and air temperature, humidity, and light intensity have a significant impact on the surface activity of the ants.

COMPARISON OF DEN SITE CHARACTERISTICS FOR NORTHERN FLYING SQUIRRELS IN TWO DIFFERENT AGE STANDS IN MT. ROGERS NRA, VIRGINIA. Mundy Hackett & John F. Pagels, Department of Biology, Virginia Commonwealth University, Richmond, VA 23284. In the Southern Appalachians, the endangered northern flying squirrel (*Glaucomys sabrinus coloratus*) occupies remnant patches of red spruce (*Picea rubens* Sarg.) interspersed with northern hardwoods. Populations of *G. s. coloratus* are limited in Virginia to the Mt. Rogers National Recreational Area (NRA). To date, few studies have provided quantitative information on den site characteristics of *G. s. coloratus* in the southern Appalachians. During 2000-2002, we used telemetry to locate 25 den sites for 12 squirrels. Den sites included cavities in live and dead residual growth trees (dbh > 35 cm dbh); cavities, and drays in mature growth trees (10-35 cm dbh); and dens in subterranean root masses of fallen trees or in rock falls. All dens located in dead trees at our two study sites, Whitetop Mountain and Cabin Creek, were yellow birch (*Betula alleghaniensis* Britton.). Ninety-five percent of dens located in live trees at Cabin Creek were in yellow birch. Forty-five percent of dens located in live trees at Whitetop Mountain were in yellow buckeye (*Aesculus octandra*). Subterranean nests were utilized 28% and 29% of the time respectively at Cabin Creek (n=5) and Whitetop Mountain (n=2).

TRENDS THROUGH TIME: 57 YEARS OF SPRING ARRIVAL DATES FOR NEOTROPICAL MIGRANTS IN CENTRAL VIRGINIA. P. A. Bedell, 10120 Silverleaf Terrace, Richmond, VA 23236. There is recent evidence that the breeding phenology of some species of birds may be responding to climate change. This response may be reflected in the spring arrival dates of neotropical migrants. I assembled arrival dates for 43 locally common species of neotropical migrants

in central Virginia spanning the years 1945 - 2001. Regression analysis showed 22 species arriving significantly earlier over the 57 - year period. Twenty species showed no significant change, and only one, the American Redstart (*Setophaga ruticilla*), trended later ( $n = 52$ ,  $t = 2.05$ ,  $P = 0.046$ , slope = 0.111 days per yr). The Eastern Pewee (*Cantopus virens*), though not significant at  $P = 0.05$ , is also trending later ( $n = 54$ ,  $t = 1.88$ ,  $P = 0.064$ , slope = 0.064 days per yr). Detectability of migrants by field observers may be a reflection of changing population size. But there was no association between arrival trends and North American Breeding Bird Survey population trends ( $df = 2$ ,  $\chi^2 = 0.605$ ,  $P = 0.717$ ).

ASSESSMENT OF BIOLOGICAL INTEGRITY IN AN AGRICULTURALLY IMPACTED VIRGINIA MOUNTAIN STREAM. J. H. Roberts<sup>1</sup>, T. J. Newcomb<sup>1</sup>, & M. J. Pinder<sup>2</sup>, <sup>1</sup>Department of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061 and <sup>2</sup>Virginia Department of Game and Inland Fisheries, Blacksburg, VA 24060. The Glen Alton Tract (GAT), a recent U.S. Forest Service acquisition in Giles County, Virginia, contains approximately three km of Big Stony Creek. One section of the GAT has a history of agricultural impacts, stemming from unrestricted cattle access to the stream. We sought to determine the effects of these impacts on the fish assemblage and the biological integrity of Big Stony Creek. Six fish sampling sites were distributed equally among an upstream reference reach, a central impact reach, and a downstream recovery reach. We applied the Bray-Curtis similarity coefficient to each site and determined that fish assemblage variability was higher among than within reaches. We also applied an Index of Biotic Integrity (IBI), modified for expected regional conditions, to each site. Integrity scores were generally low and decreased between upstream and downstream sites. Our study indicated agricultural impacts to the fish fauna of Big Stony Creek; however, difficulties associated with assessing biological integrity in naturally depauperate headwater streams hampered our ability to apply the IBI within the GAT.

ANT CATCH RELATED TO PITFALL TRAP TYPE IN A LONGLEAF PINE HABITAT. Deborah A. Waller, Department of Biology, Old Dominion University, Norfolk, Va 23529. Ants perform important functions in ecosystems such as predation, seed dispersal, pollination, soil aeration and nutrient translocation. Pitfall traps are one of the most effective methods of sampling ants, but trap design has received little attention. In the present study I compared ant catch in two trap types: empty 250 ml cups and 16 x 50 mm testtubes partially filled with soapy water. The study was conducted at the Blackwater Ecological Preserve in Isle of Wight County, Virginia, in August 2001. Two perpendicular 100 m transects were placed in each of two sites. Every 10 m along the transects, one testtube and one cup trap were sunk level to the ground. Traps were collected after one week, replaced, and collected again the following week. Ants were identified to species in the laboratory. The testtube and cup traps collected 26 and 11 ant species, respectively. No ant species were collected in the cups that were not present in the testtubes. Significantly more ant species were collected in testtubes than in cups at each trap location. In addition to collecting more ants, testtube traps are more compact, portable and durable than cup traps, and they pose less danger to vertebrates which can inadvertently fall into the cups.

LIFE HISTORY ASPECTS OF THE CREEPER, *STROPHITUS UNDULATUS*, AND GREEN FLOATER, *LASMIGONA SUBVIRIDIS* (BIVALVIA: UIONIDAE). R. Mair, J.W. Jones, and R.J. Neves, Department of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, Virginia 24061. Freshwater mussels have a unique life cycle that requires the use of a host fish to transform their larvae (glochidia) into juveniles. Both of these mussel species have large hooked, triangular glochidia that are capable of both directly transforming into juveniles inside the gills of the female mussel, and by using a host fish. *L. subviridis* was once common in Virginia, but now it is becoming increasingly rare in the state. However, this mussel species still can be found in the Potomac, Rappahannock, York, James, Chowan, New, Dan and Roanoke River systems. It prefers areas in rivers with slow to moderate flow in a substratum of sand and fine sediments. This mussel species also is a hermaphrodite. Fecundity of four females ranged from 6,000-12,000 glochidia per mussel. S.

*undulatus* is widely distributed in streams throughout Virginia. It inhabits areas in streams with moderate to slow flow, also preferring a substratum of sand and fine sediments. This mussel is capable of using many species of fish as host to its glochidia. Fecundity of three *S. undulatus* females ranged from 12,000-42,000 glochidia per mussel. Glochidia were contained in conglutinates which ranged in length from 2.95-3.28 mm. Glochidia length ranged from 0.38-0.43 mm. Glochidia were observed sliding-out of conglutinates 2-10 minutes after they were removed from the gills of the female mussel. The movement of glochidia out of the conglutinates seems to be related to kinetic energy produced by the expansion of conglutinates as they absorb water.

USING ZEBRAFISH SURVIVORSHIP TO MONITOR ORGANIC POLLUTANTS IN SEDIMENTS OF VIRGINIA WATERS. Robert M. Northington & Timothy W. Stewart, Department of Natural Sciences, Longwood College, Farmville, VA 23909. Human activities have led to increased industrial pollution of the environment. Many of these chemicals, when dumped into aquatic ecosystems, bind to sediment particles at the bottom of the water systems. When benthic-feeding organisms feed from this contaminated sediment, abnormalities may result in subsequent generations. These abnormalities may eventually lead to the organism's death. The effects of chemical pollution can be seen in the laboratory using model organisms, such as zebrafish (*Danio rerio*). Zebrafish embryo survivorship in pore water extracted from aquatic environments in Lake Michigan sites was analyzed. Statistical analyses indicated nearly significant ( $p = 0.055$ ) mean survivorship between water treatments. Further studies of embryo survivorship in Virginia sediment samples will be carried out in the future. These studies will help to assess the level of sediment contamination using samples from ecosystems with differing levels of industrialization. Zebrafish survivorship will be used as an indicator of the level of toxicity of different sediments.

EFFECT OF PRESCRIBED BURNS ON INSECT DIVERSITY IN A LONGLEAF PINE HABITAT. Charles F. Abadam & Deborah A. Waller, Department of Biology, Old Dominion University, Norfolk, Va 23529. The Blackwater Ecological Preserve, the northernmost stand of reproducing longleaf pine, is managed with prescribed burns. The objective of the present study was to examine the impact of the burns on the insect fauna. Four malaise traps were installed at the preserve, two in areas that were burned in 2001 and two in control areas that had never been burned. Traps were collected every week beginning February 15, 2002. The insect catch was preserved in alcohol and later sorted to order. Soil and air temperature were measured weekly at each trap site. Results were tabulated through April 19, 2002. Total numbers of insects did not differ for burned and control sites, but different orders varied significantly in number, with Diptera the most numerous. There was a significant increase in numbers of insects in all orders over time. Numbers of Hymenoptera were significantly greater in the control sites than in the burned areas. However, there was no difference between burn and control sites for numbers of Coleoptera, Diptera, Homoptera or Lepidoptera. Both soil and air temperature increased significantly over time. Air temperature was significantly greater than soil temperature, but there was no difference in either air or soil temperature between burned and control sites.

SUBTERRANEAN TERMITE (ISOPTERA: RHINOTERMITIDAE) RESPONSE TO ESSENTIAL OILS. Laura K. Baron & Deborah A. Waller, Department of Biology, Old Dominion University, Norfolk, Va 23529. Subterranean termites are important structural pests in urban ecosystems. New baiting technologies show promise for termite control, but drawing termites to bait stations is often problematic. Chemical attractants might increase bait effectiveness. We examined the response of the Eastern Subterranean Termite, *Reticulitermes flavipes* Kollar, to different essential oils (four pure oils and one blend). Experimental units consisted of a central 50 cc cup connected by straws to four similar cups (two treatment and two control cups). All cups were filled with 40 cc sterilized sand and 10 ml deionized water. Nine termite workers and one soldier were added to the central cup. Each treatment and control cup received a 6 mm diam red paper circle. A drop of essential oil was added to the treatment paper, and the control paper was untreated. Two

experimental units were set up for each of six *R. flavipes* colonies for each oil. After one week, workers and soldiers in treatment units were counted and categorized as either live white (unfed), live red (fed on red paper), dead white (unfed) or dead red (fed on red paper before dying). Different oils had significantly different proportions of these termite categories.

**ANURAN OVIPOSITION SITE SELECTION: HOW BEHAVIOR INFLUENCES COMMUNITY STRUCTURE.** J. F. Rieger, C. A. Binckley & W. J. Resetarits Jr., Department of Biology, Old Dominion University, Norfolk, VA, 23529. While patterns of larval amphibian distributions and abundances have been ascribed to direct predation, adult oviposition site selection is an alternative mechanism which can produce identical larval distributional patterns. Such behavioral habitat selection has been documented in several amphibian species whose larva lack anti-predator defenses. However, the sensitivity of adult amphibians to detect predator cues and avoid these habitats has not been determined. Furthermore, if larval survivorship is greatly reduced in sites containing fish, there should be strong selection to detect and avoid habitats with low fish densities. We conducted two experiments, which (1) evaluated the ability of ovipositing *Hyla femoralis* to detect varying densities of a predatory fish (*Umbra pygmaea*), and (2) quantified larval performance under varying densities of these predators. Experiments utilized wading pools in a complete randomized block design with treatments levels of 0, 1, 2, 3, 4, 5, and 6 individual fish per pool. Data from the two experiments suggest that *H. femoralis* can detect low densities of fish and oviposit in habitats that result in higher offspring survivorship.

**HABITAT USE AND EXPLOITATION OF THE STRIPED BASS AND HYBRID STRIPED BASS IN CLAYTOR LAKE, VIRGINIA; PRELIMINARY FINDINGS.** John M. Kilpatrick, Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, Va 24061. We investigated the habitat use, movements, and exploitation of striped bass and hybrid striped bass in Claytor Lake Virginia. The following is preliminary data collected during 2001. Striped bass (SB) (n = 9) and hybrid striped bass (n = 11) (HSB) were fitted with temperature sensitive radio tags and located bi-weekly. In addition, SB (n = 19) and HSB (n = 136) were fitted with internal anchor reward tags to determine angler exploitation. There were 10 reported recaptured HSB and 3 recaptured SB, for respective 7.4% and 15.8% exploitation rates. We found an insignificant difference (p = 0.112) in temperature use and a significant difference (p = 0.004) in dissolved oxygen use over the time periods sampled for SB and HSB. There is significant evidence (p = 0.001) that a difference exists for the interaction by species and month for temperature and dissolved oxygen use. Home range and movement calculations will be determined following collection of a full year of data. These results are meant as preliminary findings only and are based on only a partial year of data and small sample size. Therefore, extreme caution should be used when interpreting statistical results.

**AN UNUSUAL COAT COLOR PATTERN IN A NORTHERN SHORT-TAILED SHREW, *Blarina brevicauda*.** George B. Bumann and Patrick F. Scanlon. Department of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061-0321. On 12 November 1999, a small mammal specimen was brought to our laboratory and identification of the specimen was requested. The mammal was a victim of the presenter's cat and had been caught a few days earlier within the town limits of Blacksburg, VA. The specimen was identified as a northern short-tailed shrew, *Blarina brevicauda*, and was remarkable in that a considerable portion of the fur covering the abdomen was white in color. Some white fur extended to the flanks of the shrew and the dorsal surfaces of both hind feet had some white fur. The specimen here differed from that in a recent report on a white-belted coloration pattern in a *B. brevicauda* specimen from Henry County, VA, (Moncrief and Anderson, Am. Midl. Nat. 137: 397-400) in that the white coloration is mostly ventral with only a limited amount of white coloration extending laterally on both flanks while their specimen had dorsal white coloration. Walter Niehaus kindly provided the specimen.

## Psychology

AT-RISK STUDENT ALCOHOL USE: ASSESSING THE EFFECTS OF FRONT-LOADING AT FRATERNITY PARTIES. I. J. Ehrhart, M. L. Stuart, S. R. Rayne, & S. M. Krepinevich. Dept. of Psych., VA Tech. Alcohol contributes to the leading causes of accidental death in the United States, such as motor vehicle crashes and falls. This study examined the effect of front-loading (consuming alcohol before going to a party) on blood alcohol concentration (BAC). Data were collected at seven different fraternity parties over three semesters ( $N = 708$ ). The mean BAC for all participants was 0.083. The mean number of drinks front-loaded was 3.16. Results showed that Front-Loaders were more intoxicated than Non-Front-Loaders ( $p < .001$ ). Front-Loaders had a mean BAC of 0.092 while Non-Front-Loaders had a mean BAC of 0.067. It was also found that males Front-Loaded more than Females. Males had an average of 3.82 drinks while females had an average of 1.77 drinks before attending a party. An analysis of variance showed a Gender by Greek Status interaction ( $p < .05$ ). Greek men Front-Loaded less than non-Greek men. Conversely, Greek women Front-Loaded more than non-Greek women. Implications suggest that Front-Loading contributes significantly to overall BAC for the evening.

ALCOHOL FRONT-LOADING: AN ASSESSMENT OF NEGATIVE OUTCOMES AND DESIGNATED DRIVER USE. M.L. Stuart, I.J. Ehrhart, B.A. Kain, & T.E. Smith. Dept. of Psych, VA Tech. Students were randomly approached in a bar setting and asked questions regarding front-loading (drinking alcohol in preparation of going to a bar), their experience with negative outcomes, and designated driver use. They were then administered a breathalyzer test to assess their actual blood alcohol concentration (BAC). A total of 294 participants were interviewed. Of these, 43 said they had only front-loaded that evening, whereas 159 said they had front-loaded and consumed alcohol while in the bar, and 68 had only consumed alcohol while in the bar. The mean BAC for all participants was .081. The mean BAC level of those who only front-loaded was .058, whereas the mean BAC of those who front-loaded and consumed alcohol in the bar setting was .103, and those who only consumed alcohol in the bar setting had a mean BAC of .074. The mean number of negative outcomes of those who only front-loaded was 2.95, whereas the mean number of negative outcomes of those who front-loaded and consumed alcohol in the bar setting was 4.39, and those who only consumed alcohol in the bar setting had a mean number of negative outcomes of 2.71. Implications of these findings for preventing driving under the influence of alcohol (DUI) are discussed.

TEST-RETEST RELIABILITY OF THE DULA DRIVING INDEX. D.J. Ramsey, C.S. Dula, & S.M. Krepinevich. Dept. of Psych. VA Tech. Dangerous driving is a serious problem that plagues our country and is becoming more prevalent with the increase of the use of motor vehicles. We are attempting to provide a measure that would assess personality traits as being a factor in dangerous driving. In this study we will be determining the test-retest reliability of a dangerous driving measure to demonstrate that dangerous driving is a personality trait and not a transient state of mind. The study will consist of undergraduate students at Virginia Polytechnic and State University enrolled in a psychology course. The students will participate in two separate testing sessions, spaced four weeks apart. To assure confidentiality students will be tracked from time one to time two by using the last four digits of their social security number and the first two letters of their mother's name. Upon the completion of the first testing session students will receive one point and after completion of the second testing session they will receive two additional points and one dollar. The answers from time one and time two will be scored and compared to establish the test-retest reliability.

PERSONALITY CHARACTERISTICS OF AGGRESSIVE DRIVERS. Michelle L. Rose<sup>1</sup>, Bryan E. Porter<sup>1</sup>, and Thomas D. Berry<sup>2</sup>, <sup>1</sup>Dept of Psych, Old Dominion University, Norfolk, VA, 23529-0267 and <sup>2</sup>Dept of Psych, Christopher Newport University, Newport News, VA, 23606. This study explored the relationship between personality characteristics and aggressive driving. Aggressive driving, "the operation of a motor vehicle in a manner which endangers or is likely to endanger people

or property" is perceived to be one of many factors that is attributed the growing number of crashes on the roadways (National Highway Traffic Safety Administration, 1998, p. 1). Researchers have shown that there may be a number of personality characteristics associated with aggressive driving. This study attempted to add to this growing literature. It was hypothesized that there would be a positive relationship between aggressive driving and an individual's personality characteristics, such as stress, anger, aggression, and sensation seeking. A self-report survey was distributed to 127 college students at a large southeastern university during the spring semester of 2002. A logistic regression showed that high levels of anger was the only characteristic predicting whether individuals would pass on the shoulder when traffic was congested  $\chi^2(1) = 4.53$ ,  $p < 0.05$ ,  $R^2 = 0.04$  and that individual's believed that tailgating is an effective way of moving traffic to the right lane  $\chi^2 = 6.18$ ,  $p < 0.05$ ,  $R^2 = 0.05$ .

A COMPARISON OF TAILGATING PREVALENCE ON LOCAL TWO-LANE AND FOUR-LANE ROADS IN SOUTHEASTERN VIRGINIA. Jennifer M. Piver, Kristie L. Hebert & Bryan E. Porter, Department of Psychology, Old Dominion University, Norfolk, VA 23529-0267. This study is part of an ongoing effort to increase driver awareness of risky behaviors such as tailgating. Between February and April of 2002, several two-lane and four-lane roadways were observed in Southeastern Virginia. Drivers' mean headways (following distances behind other vehicles) were observed. Three classifications of drivers were created: followers (headways  $\leq 4$  seconds); tailgaters (headways  $< 2$  seconds); and dangerous tailgaters (headways  $< 1$  second). Two-lane roads had significantly more followers than four-lane roads, 73.6% versus 65.0%, respectively. For close followers, there were more tailgaters and dangerous tailgaters on four-lane roads than two-lane roads. It is important to note that even though there were more followers on two-lane roads, this did not translate into more tailgating. The headways for followers, tailgaters, and dangerous tailgaters were all less on four-lane roads than two-lane roads. In future research, we hope to discover why there are more followers on two-lane roads but more tailgating and dangerous tailgating on four-lane roads.

WHO'S ON MY BUMPER? : DEMOGRAPHIC PREDICTORS OF INDIVIDUALS WHO FOLLOW TOO CLOSELY. Courtney P. Schubert, Kristie L. Hebert, Sarah A. Matthews & Bryan E. Porter, Department of Psychology, Old Dominion University, Norfolk, VA, 23529-0267. The current study examined the relationship between the risky driving behavior of following too closely (tailgating) and demographics (safety belt use, gender, and vehicle type). Between May and September of 2000, 3,160 vehicles were observed in Southeastern Virginia along a four-lane divided highway and an interstate site. Demographics, as well as following distance between vehicles (headway), were observed and recorded. Vehicles with headways  $\leq$  four seconds - "followers" who had the opportunity to tailgate - were used for analyses ( $n = 2,448$ ). A multiple regression analyzing mean headways found only vehicle type contributed significant variance. SUVs and light trucks had smaller headways than passenger cars. Vehicles with headways less than two seconds were then classified as tailgaters. A logistic regression analysis indicated that drivers on the interstate were 1.23 times more likely to be tailgaters than drivers on four-lane roads, and drivers in SUV's and small trucks were 1.22 times more likely to be tailgaters than drivers in passenger cars. Gender and belt use did not predict tailgating classification.

DEMOGRAPHIC PREDICTORS OF TAILGATING RELATED CRASHES. Sommer N. Thompson, Michelle L. Rose, Bryan E. Porter, Department of Psychology, Old Dominion University, Norfolk, VA, 23529-0267. This study attempted to create a demographic profile of tailgaters whose behavior led to crashes. As part of a larger study in 2001, police crash reports from tailgating-related incidents were collected from southeastern Virginia cities over a three-week period. Five hundred and sixty such reports were collected. Overall, there were 43.8% female and 56.2% male drivers who caused these crashes. Their mean age was 32.01 years. Results indicated women and young drivers were more likely to be cited for tailgating crashes. Other contextual variables indicated that tailgating crashes occurred more on Wednesdays and during the afternoons. In addition, these tailgating

crashes were compared with Virginia crashes at large to better understand if tailgating involved different crash predictors.

EFFECTS OF EXPOSURE TO *PFIESTERIA SHUMWAYAE* TOXIN AND SCOPOLAMINE ON RAT PERFORMANCE IN THE DELAYED RADIAL-ARM MAZE. Sarah A. Schultz<sup>1</sup>, Perry M. Duncan<sup>1</sup>, Brian Dyer<sup>2</sup>, and Howard Marshall<sup>2</sup>, <sup>1</sup>Department of Psychology, Old Dominion University, Norfolk, VA and <sup>2</sup>Department of Biological Sciences, ODU. *Pfiesteria shumwayae* is a recently identified toxic dinoflagellate. The ichthyotoxic properties of this organism have been established but the neurotoxic effects of exposure to this organism are unknown. The purpose of this experiment was to investigate the toxic effects on behavior and cognition in rats exposed to *pfiesteria* by toxic filtrate injection. The researchers utilized a delayed radial-arm maze procedure that allows testing for both reference memory errors (RME) and working memory errors (WME). Pf-exposed rats make significantly more total errors (RME + WME) than control rats exposed to a control filtrate injection. Scopolamine is a cholinergic (muscarinic) antagonist drug that has been previously shown to impair memory in humans and animals. Pf-exposed rats perform more poorly than controls in the delayed RAM procedure after Scopolamine injection but this finding only indicated a non-significant trend. It seems that Pf-exposed rats are more sensitive to Scopolamine's effect but more research is needed before this can be conclusively stated.

AN INVESTIGATION OF CONTROL CONDITIONS IN ASCH-TYPE EXPERIMENTS: III. Neysa L. Isler, Natalie A. Clouser & James P. O'Brien, Tidewater Community College, Virginia Beach VA 23456. Results are reported for the third year of a study to validate Asch's (1951, 1956) independence-conformity stimuli for clarity in a 2x2x2x2 protocol (S's sex and 4-yr. undergraduates vs. community college students; authoritative vs. peer experimenter and E's sex). With the addition of 105 Ss this year [earlier results reported in *Va. J. Sci.*, 51 (2), p. 132 & 52 (2), pp. 127-128], data has been acquired for 322 Ss and 3 of 16 cells have been completed with  $n \geq 37$  (Asch's control condition N). Measures (mean error and % Ss error-free) are more extreme than Asch's, indicating that his stimuli do not constitute "an utterly clear perceptual fact" for all people in various situations. Yet dozens of subsequent investigators, in replicating only Asch's experimental conditions without contemporaneous and comparable controls, have assumed stimulus clarity. In fact, since we have found small error measures, similar to Asch's, only with white male college undergraduates (like his controls); conclusions from numerous experimental condition replications – such as, women conform more than men – may be erroneous. After all, as Asch demonstrated, "with diminishing clarity of the stimulus-condition the majority effect increases" in the group-pressure condition.

AN EXPLORATORY ANALYSIS OF ABERRANT COMPANION ANIMAL BEHAVIORS ASSOCIATED WITH RELINQUISHMENT. A. L. Cincotta, H.B. Sewell, A. K. Fournier, & E. S. Geller. Dept. of Psyc., VA Tech. Millions of companion animals are relinquished to shelters and euthanized each year because of aberrant pet behaviors and pet owners' personal reasons. The present study explored behavioral determinants of pet relinquishment at two local shelters. Data collection incorporated archival data, evaluating demographic information of each animal and the adoption and relinquishment records of animals in two animal shelters during 2001. 1,379 records of individual animals were evaluated, and animals were classified by reasons admitted to shelter, reasons for relinquishment, age, and outcomes of relinquished animals. Results showed 34.3% of animals in shelters were relinquished by their owners. It was predicted that the most frequent reason reported for animal relinquishment would be aberrant animal behaviors. The majority of the owners reported personal reasons to be the reason for relinquishment; the second most common reason was aberrant pet behaviors. Implications for future educational and behavioral interventions are discussed.

A COMPARISON OF RECIPROCITY VERSUS THE THREE-TERM CONTINGENCY IN SOLICITATION APPROACHES. S. L. Rosti, J. S. Hickman & S. E. Geller, Dept. of Psych., Va. Polytechnic Inst. & State Univ., Blacksburg, Va 24061. The current study assessed the percentage of pedestrians solicited in three different conditions, Reciprocity (R), 3-Term Contingency (3T), and Control (C) solicitation approaches. A total of 453 pedestrians participated in the study located on the Virginia Tech campus. During spring 2002, pedestrians were approached in the Derring Hall first floor lobby and outside the Newman library using one of the three solicitation approaches (R, 3T, or C). In the R approach, pedestrians were given a free gift, (i.e., an American flag pin). Upon the pedestrian's acceptance of the pin, they were asked to complete a brief survey. In the 3T approach, pedestrians were asked if they wanted to complete a brief survey and upon completion would receive a small gift (i.e., an American flag pin). The C approach was similar to the 3T approach, except no small reward was given upon completion of the survey. The results show that pedestrians solicited with the R approach agreed to complete the survey on 39.6% of the trials, 25.5% in the 3T approach, and on 29.2% of the trials in the C approach. Results showed that pedestrians who were solicited with the R approach completed the survey significantly more often than pedestrians solicited in the 3T condition.

SOCIAL INFLUENCE: CONSIDERATION OF SPECIAL INTEREST GROUPS. S.M. Krepinevich, C.S. Dula, D.J. Ramsey, & J.G. Franks. Dept. of Psc. VA Tech. This study incorporated the six social influence principles, as they are described by Cialdini (2001), into a survey that was then administered to 853 Introduction to Psychology students, 35 cadets from the universities Corps of Cadets, and 41 members of a service fraternity. The results found that the survey used, the Social Influence Survey, had external validity. The cadets scored significantly higher in authority, as was hypothesized, and the service fraternity though not significantly different from the Introduction to Psychology students, was significantly higher in reciprocity than the cadets. Both the cadets and the service fraternity were overall more influenceable than the Introduction to Psychology students, which was also hypothesized. All of this suggests not only that the survey was measuring what it was believed to be measuring, but also that the individual social influence principles are trait like where members of these groups as a whole appear to have more similar than dissimilar profiles.

SOCIAL INFLUENCE SURVEY: EMERGING PATTERNS IN STUDENT POPULATIONS AND THE DEVELOPMENT OF A NOVELTY SCALE. P. K. Lehman, C. S. Dula, E. S. Geller, D. Grandin. Dept. of Psych., VA Tech. Social psychologists have documented several social influence principles that have a profound impact on human behavior and are frequently used as compliance tools by sales and marketing professionals. A scale designed to measure individual differences in propensity to be influenced by Novelty was developed and added to an existing Social Influence Survey (SIS) designed to measure individual differences in susceptibility to the influence principles of Consistency, Reciprocity, Ingratiation, Conformity, Authority and Scarcity. To construct the Novelty scale, seventeen questions were created to measure preference for Novelty across a variety of situations and administered in Likert scale format to 103 undergraduate students. Factor analysis was used to select 7 items for the final scale. The complete SIS was administered to 614 undergraduate students in an introductory psychology course. Mean scores were highest for the Consistency (40.9) and Reciprocity (40.4) scales, followed by Novelty (33.0), Authority (31.6), Scarcity (31.3), Ingratiation (30.5) and Conformity (20.6). Mean scores for females were significantly higher than those for males on all scales except Conformity and Ingratiation ( $p < .01$ ).

SAFETY SELF-MANAGEMENT IN MINING OPERATIONS. J. S. Hickman, E. S. Geller, A. L. Cincotta, S. L. Rosti, S. L. & D. Grandin, Department of Psychology, Virginia Polytechnic Institute and State University, 5100 Derring Hall, Blacksburg, VA 24061. This quasi-experimental field study examined the efficacy of a safety self-management intervention to increase safety-related work practices in mining operations. A total of 15 male miners participated in the study while engaging



in their normal work practices at the Virginia Tech Quarry, located in Blacksburg, Virginia. The study had two groups, *Feedforward* ( $n=8$ )--participants self-recorded their intentions to engage in specific percentages of safety-related work behaviors *before* starting their shift for the day, and *Feedback* ( $n=7$ )--participants self-recorded their percentages of safety-related work behaviors *after* their shift for the day. Trained research assistants made a total of 10, 905 obtrusive behavioral observations on three target behaviors (ear plugs, dust mask, and safety glasses) and five non-target behaviors (gloves, hard hat, boots, knee position during lifts, body position during lifts) across phases. Results showed the safety self-management intervention significantly increased safety performance across both target and non-target behaviors during the Intervention phase.

AGE DIFFERENCES IN APPROPRIATE NAVIGATIONAL COMMAND DISTANCE: A DRIVING SIMULATION STUDY. Rebecca D. Ferris<sup>1,2</sup>, Carryl Baldwin<sup>1</sup> & Barbara Freund<sup>2</sup>. <sup>1</sup>Dept. of Psychology, Old Dominion University, Norfolk, VA 23507, <sup>2</sup>The Glennan Center, Eastern Virginia Medical School, Norfolk, VA 23507. Using auditory commands as an aid for older adults using in-vehicle navigation systems may be a safer means than using visual displays. Command distance was examined in an attempt to find an ideal distance from turn command to intersection. Participants were 16 older (age 65-80) and 16 younger (age 20-35) adults in self-reported good health with at least 3 years of driving experience, screened for dementia and hearing loss. Each participant drove 3 driving simulator scenarios--either short, medium or long command distances and completed a subjective questionnaire (NASA-TLX) as a measure of self-reported mental workload. A significant number of the older participants failed to complete turns during the short scenario, possibly due to feelings that they would not complete the turn safely or the older adults may not have had sufficient time to cognitively process the turn command before arriving at the intersection. The NASA-TLX was also significant. All participants rated the short distance the most difficult, medium less difficult and long the least difficult, with the older group ratings significantly higher than the young group overall.

ALARM RELATED INCIDENTS: A REVIEW OF THE U. S. ARMY AVIATION SAFETY DATABASE. Colleen M. Moore & James P. Bliss, Dept. of Psychology, Old Dominion University, Norfolk, VA 23529. In the complex environment of today's aviation cockpits, it is important to have reliable alarm systems. In the situation of an alarm, the pilot must be able to make a quick and accurate assessment of the alarm as well as continue with his or her primary tasks. Studies have shown "cry-wolf" effects and delays in response to alarms and mistrust in alarm systems in a laboratory setting. However, there is no applied research due to the difficulty of performing studies onboard aircraft. Therefore, accurate alarm rates are difficult to determine. The following study reviewed the U.S. Army aviation safety database for incidents and accidents involving warning signals. Researchers focused on false and missed alarms. Of the 479 cases reviewed 90% were false alarms and 4% were missed alarms. These results suggest sensitive warning systems in Army aircraft.

LEADERSHIP STYLE AND PERFORMANCE IN TELEWORK: A SECONDARY DATA ANALYSIS. Rebecca D. Say, & Donald D. Davis, Dept. of Psychology, Old Dominion University, Norfolk, Virginia 23529. Telework encompasses those options available to persons who work outside of the traditional office. Teleworkers and those persons who lead teleworkers must have specific characteristics to ensure success. The present study examined the impact of two types of leadership, transactional and transformational leadership, on teleworker task and contextual performance using data collected via an on-line questionnaire. Although relationships between leadership and employee performance have been previously identified for on-site workers, it is important to determine their application to teleworkers. The sample includes 36 teleworkers from two companies. Results of two sequential multiple regressions indicate that after controlling for average number of days teleworked, transactional leadership significantly predicted both task and contextual performance of teleworkers. Results also indicate that transformational leadership did not significantly predict either performance type. These findings suggest that transactional leadership

methods may be the most effective way to lead teleworkers. Further research should be conducted to determine the precise relationships between leadership and performance for teleworkers.

HOW ECONOMIC FACTORS ARE RELATED TO ARMY RETENTION RATES: A TIME SERIES ANALYSIS. James R. Camie & Robert M. McIntyre, Psychology Department, Old Dominion University, Norfolk, VA, 23529. The relationship between economic factors and Army retention rates was examined using a time series analysis. The analysis was conducted using archival data drawn from fiscal year 1979 through 1999 of U.S. Army Soldiers. The data consisted of 126,312 enlisted soldiers from the 1979 cohort. The first hypothesis tested if different economic factors impacted enlisted retention rates over time. A second hypothesis tested if significant world events can be detected through a time series analysis by examining the occurrence of either pulse or level shifts. The results support both hypotheses and indicate future studies involving time series analysis with retention data would be useful in building more accurate retention models for U.S. Army enlisted soldiers.

THE INFLUENCE OF ITEM WORDING ON QUESTIONNAIRE SCALE SCORES. Nicole Anne Benn & Terry D. Dickinson, Department of Psychology, Old Dominion University, Norfolk, VA, 23529. Psychological researchers need methods for obtaining accurate responses from participants when using questionnaire data. The current study looked at the influence of negatively worded scale items on the overall scale. The NEO-PI was used to test the impact of negatively worded items. The NEO-PI was transformed to create four altered versions; each version contained differing amounts of negatively worded items. More than 1,100 participants were used in this study, with approximately 230 people in each subgroup. Confirmatory factor analysis, along with various goodness-of-fit measures, was used to test the results. Results show that negative wording affects the measurement properties of scales. Implications, limitations and ideas for future research are addressed.

DIFFERENTIATION OF SELF AND INDIVIDUATION IN COLLEGE STUDENTS. D. S. Vick, Virginia Consortium Program in Clinical Psychology Virginia Beach, VA 23462 & J. A. Morrow, Old Dominion Univ., Norfolk, Va.23529-0267. This study explored the relationship between Bowen's (1978) construct of differentiation of self and Erikson's construct of individuation (1963) for traditional aged college students. Using non-probability sampling, the study included an ethnically diverse population of 84 college freshmen through seniors from a large, public southeastern university. The Differentiation of Self Inventory - DSI (Skowron, 2001) and the Psychological Separation Inventory - PSI (Hoffman, 1984), revealed a significant gender difference for Emotional Cutoff. No significant differences were revealed in looking at the DSI and PSI by class year. Significant negative correlations were identified between three DSI factors and the PSI factor Conflictual Independence.

ETHNIC DIFFERENCES IN SIBLING RELATIONSHIPS USING THE RSRI. Denise L. Miles & Jennifer Anne Morrow, Dept. of Psychology, Virginia Consortium Program in Clinical Psychology & Old Dominion University, Norfolk, VA 23529. Gaining understanding into the dynamics and ethnic differences in sibling relationships in young adulthood is beneficial in such realms as support networks, family therapy and coping strategies. This study modified the Sibling Relationship Inventory (RSRI) and examined the three specific factors of Affection, Hostility and Rivalry in young adult sibling relationships. In addition to testing the RSRI's reliability, it was compared to The Adult Sibling Relationship Questionnaire (ASRQ), which had the three comparable factors of Warmth, Conflict and Rivalry. One hundred and forty under-graduates (66 African American and 74 Caucasian) completed both surveys. Statistics indicated that the RSRI is an adequate measure of sibling relationships in young adulthood and that its relationship with the ASQR was such that Affection/Warmth and Hostility/Conflict had a significant positive correlation. This study also

examined ethnic differences on the three factors used in each scale. The study showed that Caucasian and African American young adults perceive their sibling relationships similarly over all the factors.

STUDY STRATEGY USE IN RELATION TO TEST ITEM ASSESSMENT. S. A. Bass, E. M. Justice & L. Briggs, Department of Psychology, Old Dominion University, Norfolk, VA 23508. Past research has illustrated the notion that successful educational outcomes are, for the most part, dependent upon how students process information as well as how students allocate their study time. The present research investigated whether a relationship exists between the types of study activities that students employ (i.e., strategy use) and their performance on different types of test questions. The degree to which students engage in different kinds of study activities was assessed using Form R of the Study Activity Survey (SAS-R). SAS-R scores were correlated with the percentage correct on different types of test questions. Researchers also attempted to reliably code multiple choice exam items according to the categories in the revised version of Bloom's taxonomy. Through use of these measures, the current study attempted to establish a relationship between different types of strategy use in conjunction with different types of questions. Correlations among SAS-R subscales, student demographics, and overall course performance indicated significant relationships between these constructs. Results of three stepwise multiple regression analyses indicated the subscales of Hyperprocessing and Self-Evaluation of Cognitive Ability to be significant predictors of overall course performance. Limitations and implications of the current research were addressed. It was concluded that the revised version of Bloom's taxonomy was insufficiently reliable in terms of classification of test items. Researchers further concluded that selective and self-monitoring study strategies appear to best predict overall course performance.

DEVELOPMENTAL CORRESPONDENCE OF THEORY OF MIND AND INTENTIONAL STRATEGY USE. Corrine E. Spiess & Elaine M. Justice, Dept. of Psychology, Old Dominion University, Norfolk, VA 23529. Children's understanding of intentions and strategy use was examined through interviewing 33 children enrolled at the Old Dominion University Child Development Center. Children of 4- and 5-years of age were told 8 stories and answered questions pertaining to the beliefs, desires, intentions, and surprise of characters in each story. Four intention and four strategy stories were narrated to each child. The results indicated no significant distinctions between genders or between age groups. However, a significant difference was discovered between the types of stories, with strategy stories easier for participants to understand.

THE IMPACT OF PERSONALITY VARIABLES ON ACADEMIC PERFORMANCE. Elizabeth Schmidt & Alice Alexander, Dept of Psych., Old Dominion University., Norfolk, Va. 23529. Previous research has demonstrated the existence of a relationship between personality variables and academic performance. However, recent research has revealed more consistent findings about this relationship. The current study examined the relationship between the Big Five personality variables (Extraversion, Conscientiousness, Agreeableness, Neuroticism, Openness to Experience) and academic performance (cumulative GPA, major GPA, and Final Introductory Psychology (FIP) course grade). Ninety-nine participants (84 females and 15 males) were recruited from various undergraduate psychology courses and asked to anonymously complete the 50-item personality inventory (IPIP) and to self-report their academic performance information. Bivariate correlations, one-way ANOVA's, and multiple regressions revealed that conscientiousness, openness to experience and neuroticism (lower levels of emotional stability) related the most to academic performance.

COGNITIVE PRECURSORS TO SCIENCE COMPREHENSION. Kimberly G. Cottrell & Danielle S. McNamara, Dept. of Psychology, Old Dominion University, Norfolk, VA 23529. Cognitive factors such as reading ability, prior domain knowledge, and reading strategy knowledge were examined to determine their ability to predict comprehension of a science text and course performance. The sample consisted of 144 undergraduate students enrolled in an introductory

psychology course at Old Dominion University. Science text comprehension was significantly predicted by both prior knowledge ( $\beta=.27$ ,  $sr_i^2=.04$ ) and reading ability ( $\beta=.41$ ,  $sr_i^2=.10$ ). Better readers and students with more knowledge about psychology answered more comprehension questions correctly. Exam performance was significantly predicted by prior domain knowledge ( $\beta=.48$ ,  $sr_i^2=.14$ ). Students with more knowledge about psychology before the course began obtained higher exam scores. The metacognitive reading strategy of drawing from prior knowledge enhanced science comprehension whereas previewing, purpose setting, and self-questioning enhanced the average of exams. Greater prior domain knowledge provided no benefit for students who did not use certain types of metacognitive reading strategies. Also, the tendency to use previewing strategies only benefited students if they possessed sufficient prior domain knowledge.

THE EFFECTS OF COMMUNICATION AND AFFECTIVE RESPONSE ON HUMAN COGNITION. Laura L. Nichols & Jeffrey A. Gibbons, Dept. of Psych., Christopher Newport Univ., Newport News, VA 23606. This study assessed 5 communication modes across cognition and affect in university-level students. The goal was to make covert thoughts and feelings apparent to the conscious mind of the individual, and to increase validity of response in relation to mood. Participants were placed in 1 of 5 groups: drawing, writing, psychodrama, symbolic interpretation, and reading. Participants completed a survey measuring levels of depression, stress, and anxiety before and after the specified communication technique. As predicted, scores of participants in all 5 groups differed across the pre and post survey. However, only the scores obtained from writing, reading, and symbolism groups were significantly different across pre and post surveys. Results of this study suggest that communication techniques such as writing, reading, and symbolic interpretation are beneficial to the individual in facilitation of valid response in relation to mood.

RAT PERFORMANCE IN THE RADIAL-ARM MAZE AFTER EXPOSURE TO *PFIESTERIA PISCICIDA* TOXIN AND SCOPOLAMINE ADMINISTRATION. Brian Parris<sup>1</sup>, Perry M. Duncan<sup>1</sup>, Brian Dyer<sup>2</sup>, and Howard Marshall<sup>2</sup>, <sup>1</sup>Department of Psychology, and <sup>2</sup>Department of Biological Sciences, Old Dominion University. *Pfiesteria piscicida* (*pf*) is a toxic dinoflagellate, and these experiments were examinations of the cognitive deficit produced in rats after exposure to the toxin from this marine micro-organism. Rats were trained in an eight-armed radial-arm maze (RAM), which tests working memory. Two dependent variables were measured: total time to complete the RAM, and total errors per trial. Experimental-group rats were injected subcutaneously with filtered water containing *pf* toxin, and controls with non-toxic filtrate. In the first experiment *pf*-exposed rats learned the RAM more slowly than did controls. In the second experiment rats were trained on the RAM first and then injected with *pf* filtrate. After learning the RAM, rats in both experiments were injected with scopolamine, an anticholinergic drug which impairs memory. In each experiment the *pf*-exposed rats were much more vulnerable to the drug-produced impairment as indicated by both dependent variables. The *pf*-rats required more time to complete the RAM, and made more errors. These results demonstrate that the *pf* toxin impairs some aspect of cognitive ability and increases vulnerability to scopolamine.

THE EFFECT OF INSULIN-INDUCED HYPOGLYCEMIA ON RAT PERFORMANCE IN THE DELAYED RADIAL-ARMED MAZE. Juan Constantine & Perry Duncan, Department of Psychology, Old Dominion University, Norfolk VA. Hypoglycemia (HG) causes various types of cognitive impairment, including memory failures, in humans. The purpose of this study was to investigate the possible effects of HG on reference memory in rats trained on the delayed radial arm maze (RAM), a procedure which allows separate testing of impairment of acquisition and retrieval of memory. Rats were trained to complete the RAM with a two-hour delay between the initial and the final phases of each trial. Insulin at 2 units/kg was administered before either the initial, the final, or both RAM phases, and each treatment's effect was compared with performance in the non-drugged control condition. HG levels of between 30 and 40 mg/deciliter (about 65% of normal blood-glucose levels) occurred 20 minutes after insulin injection. The first test for HG effect on retrieval

indicated a significant ( $p < .01$ ) memory impairment, but subsequent tests found no impairment. The lack of persistent memory impairment may be a result of behavioral tolerance to HG. HG during the initial RAM phase indicated no impairment, as did HG during both RAM phases. These results of no ongoing memory impairment may be due to relatively mild HG levels, or to this specific procedure for testing memory.

POSITIVE INFLUENCES IN DEALING WITH ADVERSITY: A QUALITATIVE INVESTIGATION OF TRAUMA SURVIVORS. Jennifer Ann Morrow & Sharon Clayman, Dept. of Psychology, Old Dominion University, Norfolk, VA 23529. Many children, while growing up, have been victims of trauma; trauma such as physical, psychological, and sexual abuse, as well as general neglect and witnessing violence between adults in the home. Positive influences that children experience while growing up can have a positive impact on their adulthood functioning. Unstructured, open-ended interviewing was used to ascertain trauma survivors' positive influences that helped them successfully overcome their traumatic experiences. Sixteen female childhood trauma survivors were interviewed for this study. Positive influences that many had in common were: spirituality or faith in a higher power, self-determination, having supportive others around them, and participating in sports or the creative arts. Future research should look at how one can instill these positive influences in young adults who have been traumatized.

RELATIONSHIP BETWEEN COMMITMENT TO EXERCISE AND ANXIETY IN AMATEUR EXERCISERS. Gabriela Dye & Jennifer Ann Morrow, Dept. of Psychology, Old Dominion University, Norfolk, VA 23529. This study was designed to assess the relationship between commitment to exercise and levels of anxiety in recreational exercisers. One hundred and seventy two participants, 138 University students and 34 health club members participated in this study. Of the 172 participants, 116 were females and 54 were males (age range: 18 to 66 years old). The results did not show a significant relationship between commitment to exercise and anxiety. Anxiety and frequency of exercise was negatively correlated. Results showed that males exercise more frequently, duration of exercise is longer, and they are more committed to exercise than females. Health club members exercise more frequently, duration of exercise is longer, and they are more committed to exercise than college students. Some of the limitations of the study were: small sample size from the health club, most participants engaged in moderate levels of exercise, the research did not focus on individuals who only participate in one type of exercise activity, and the anxiety scale used in this study measured general anxiety and not exercise anxiety. Future research should look at perceived fitness and satisfaction with ones' body and their interaction with commitment to exercise and anxiety.

DISPLAY PARAMETERS AFFECTING PERCEIVED URGENCY AND ANNOYANCE IN VERBAL WARNING SIGNALS. Sarah A. Matthews & Carryl Baldwin, Ph. D., Dept. of Psychology, Old Dominion Univ., Norfolk, Va 23529. Technology is advancing at a rapid pace bringing new advances in automotive systems including computerized collision avoidance systems, in-vehicle navigational displays and motorist advisory systems. Already common in some high-end cars, these warnings will better assist drivers in situations involving potential collisions, heavy traffic, adverse weather, and other complex driving situations. One new advanced system with the potential to dramatically increase motorist safety the in-vehicle collision avoidance systems (CAS). CA systems will ultimately assist drivers and help them to drive more cautiously. This study examines the influence of different signal words and the auditory presentation levels used to present these warnings on overall annoyance and perceived urgency. Four signal words (caution, danger, warning, and notice) were used in combination with a variety of CA messages. Results indicate that both signal word and presentation levels significantly impact the perceived urgency of the verbal messages.

## Statistics

A NOTE ON THE ESTIMATION OF AUTOCORRELATION IN REPEATED MEASUREMENTS. N. Rao Chaganty & Genming Shi, Dept. of Math. and Stat., Old Dominion University., Norfolk, Va 23529. In the analysis of repeated measurements with autocorrelation, popular methods of estimation are the maximum likelihood method and the method of moments used for normal and non-normal data, respectively. An alternative is the quasi-least squares method of estimation. This method, based on the principle of generalized least squares, does not make any distributional assumptions and differs from the two popular methods in the estimation of the autocorrelation. In this paper we study the large sample properties of the quasi-least squares estimates. Using the asymptotic relative efficiency criterion, for normally distributed measurements we show that the quasi-least squares estimates are better than the moment estimates and are good competitors to the maximum likelihood estimates. If normality is not tenable, the quasi-least squares estimates could be used as an alternative to the maximum likelihood and the moment estimates. (Supported partially by a grant from the US Army research office.).

SOME OPTIMALITY OF ROW-COLUMN DESIGNS. Siriluck Jermjitpornchai, Department of Mathematics and Statistics, Old Dominion University, Norfolk, Virginia 23529 & John P. Morgan, Department of Statistics, Virginia Polytechnic and State University, Blacksburg, Virginia 24061. This work uses an infinite series of nonbinary, unequally replicated E- and MV-optimal block designs from a result of Morgan and Srivastav (1999). These designs are considered to construct E- and MV-optimal row-column designs in an experimental setting where  $v$  treatments are arranged in  $bk$  experimental units being in an array consisting of  $k$  rows and  $b$  columns. An example is demonstrated

THE EFFECT OF MISCLASSIFICATION ON CLINICAL TRIALS. Cynthia S. Cors, Department of Biostatistics, Virginia Commonwealth University. Misclassification is examined as it pertains to categorical response variables and is defined as classifying a subject to an incorrect category. Simulation studies were used to investigate the changes in power at different levels of treatment improvement (0%, 15%, and 25%), combined with different levels of misclassification (0%, 10%, and 20%), with 2, 4, and 8 outcome categories. The power function indicated that power increases when there are no misclassifications and tends to be higher with the smallest number of outcome categories. The following three categorical distributions were examined: bell-shaped, uniform, and U-shaped. This is important in the design of clinical trials because reducing the number of outcome categories should also decrease the potential for misclassification, thereby maximizing power for the study.

ADAPTIVE FOURIER ANALYSIS FOR UNEQUALLY-SPACED TIME SERIES DATA. Hong Liang & Robert V. Foutz, Department of Statistics, Virginia Polytechnic Institute and State University. Fourier, Walsh-Fourier, and wavelet analysis have been used in time series. Fourier analysis might be misleading when the periodic components are not sinusoidal. Walsh-Fourier analysis is difficult to interpret since Walsh functions are not periodic. Wavelet analysis also has flaws. It gives no exact meaning to the concept of frequency. All three methods require equally-spaced observations. In this paper, by using a sequence of periodic step functions, a new analysis method, adaptive Fourier analysis, and its theory are presented. These can be applied to time series where patterns may take general periodic shapes that include sinusoids as special cases. Most importantly, the resulting adaptive Fourier analysis does not require equally-spaced time series observations.